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cosmetic dentistry _ beauty & science

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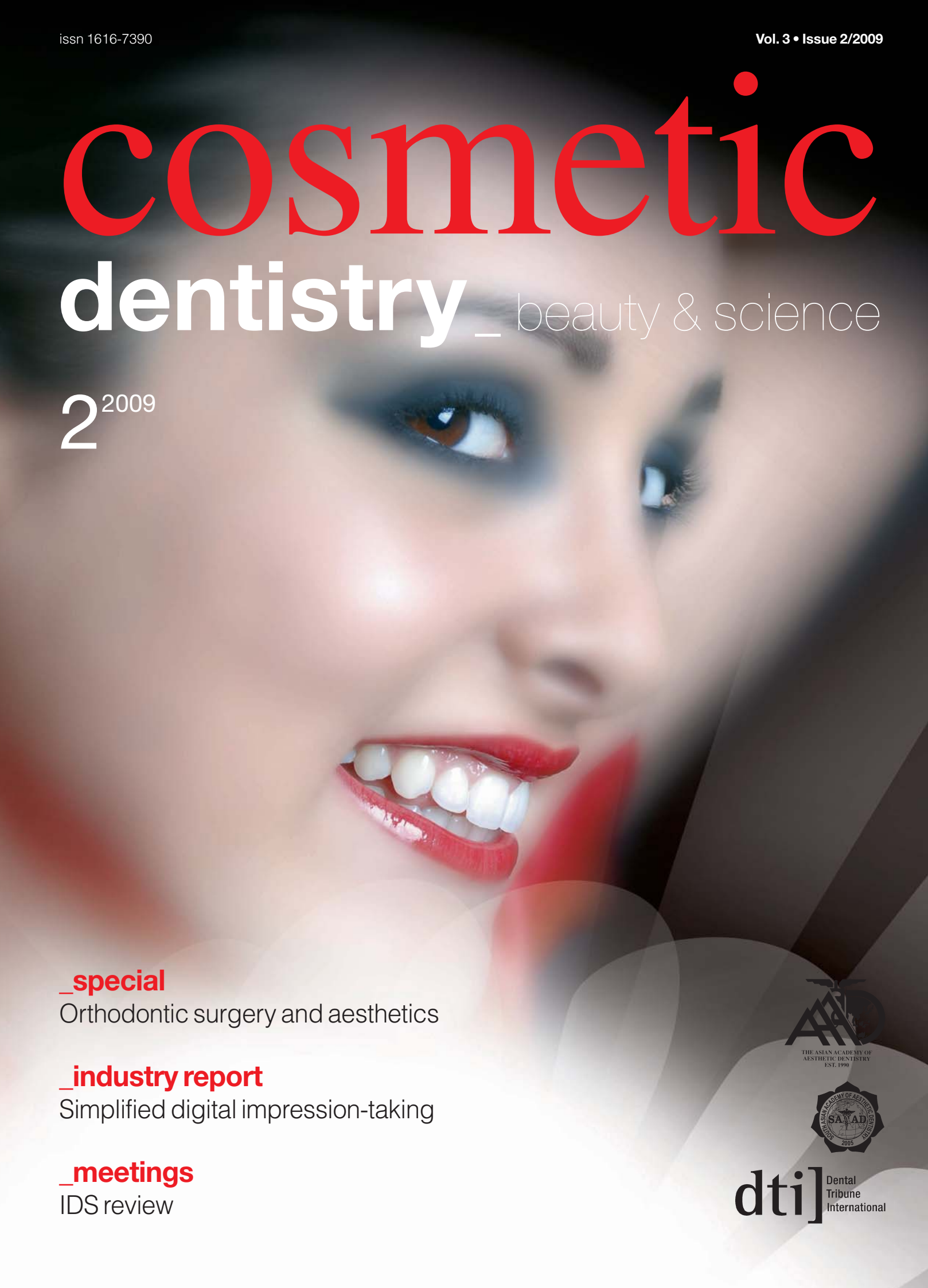

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VOCO THE DENTALISTS

Dear Reader,

Dr So-Ran Kwon
Co-Editor-in-Chief

_I sincerely appreciate the enthusiastic support of our authors for the second edition of cosmetic **dentistry** . Since we began, we have striven to fulfil the needs of our valued readers, by providing innovative and informative articles on clinical techniques and new dental technologies. So far, we have received very positive and encouraging feedback from many supporters. We are certainly grateful to have established a well-suited and efficient team in such a short time.

Cosmetic and implant dentistry have without a doubt become of central interest, attracting the interest of many dentists worldwide. At many important academic seminars or conventions, the main theme is directly or indirectly related to these two specialities. This trend is expected to be even more pronounced in the future. Dental education, from undergraduate programmes to graduate programmes and continuing education courses, exhibits a continual shift towards cosmetic and implant dentistry.

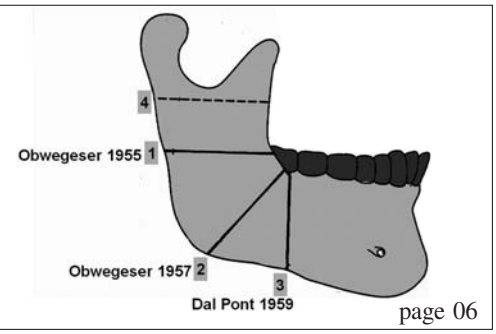
The number of patients in need of cosmetic and implant procedures is steadily increasing. I have personally witnessed this boom in Europe, Asia and the US during my international lectures and have been informed of it through regular feedback from dentists and dental hygienists. If we are to satisfy our patients' needs, additional skills and knowledge are essential.

In this edition, you will find solutions for quality and cosmetic restorations on natural teeth and implants. Our industry reports introduce innovative materials and devices that will make your clinical work not only more precise, but also much easier. I am confident that the more knowledge we have on cosmetic dentistry, the greater our success in our dental practices will be.

I hope you will enjoy this edition of cosmetic **dentistry**, and look forward to receiving your valuable feedback!

Sincerely yours,

Dr So-Ran Kwon
Co-Editor-in-Chief
President Korean Bleaching Society
Seoul, Korea



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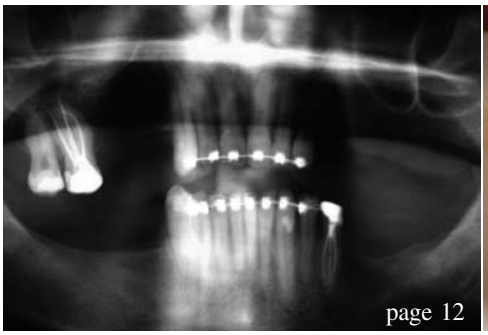
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Orthodontic surgery and aesthetics

Author_ Prof Nezar Watted, Prof Josip Bill, Dr Ori Blanc & Dr Benjamin Schlomi, Germany & Israel

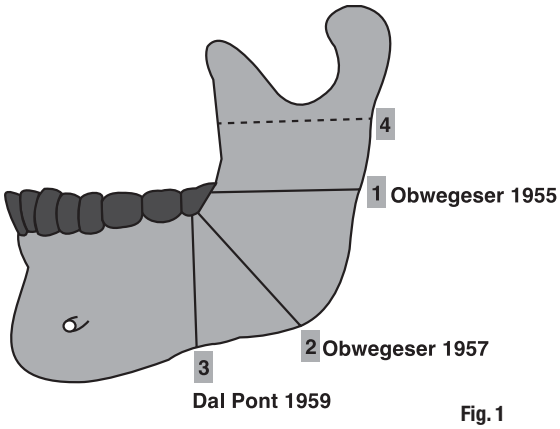

Fig. 1

Fig. 1_Diagrammatic representation of the osterotomy lines on the outer (continuous line) and the inner compacta (dashed line) of the mandible; 4 = inner saw cut above the *N. mandibularis*.

Figs. 2a & b_Lateral view of the 25-year-old male patient, showing lower facial retrusion diagonally forward. The frontal view shows the right-sided deviation due to the laterognathia. The upper-lip vermillion is relatively weakly developed (b).

_Orthodontic treatment generally follows aesthetic, functional, and prophylactic objectives, where individual aspects of isolated cases are accorded varying importance as they arise. Increasing aesthetic expectations and awareness of modern dental treatment options disseminated by the media have resulted in increased interest and greater willingness of adults to consider orthodontic treatment. Aesthetic orthodontics is thus primarily adult orthodontics.

A peculiarity of orthodontic treatment in adults compared with paediatric or adolescent orthodontics is the age-associated involution of the connective tissues that leads to a reduction in cell density, thickening of the fibre bundles, delayed fibroblast proliferation, and reduced vascularisation. These are the causes of slower dental movement and delayed tissue and bone reactions. Absent sutural growth, the age of the periodontium, specific periodontal diagnoses, and tissue atrophy also make treatment in adults particularly challenging.


Fig. 2a


Fig. 2b

As a rule, aesthetically oriented adult orthodontics therefore has an interdisciplinary inclination. Occlusion, function and aesthetics are considered to be equivalent parameters in modern orthodontics and particularly here in combined orthodontic-maxillofacial surgical treatment.[32,33] This was achieved through optimisation of diagnostic tools and further development and increasing experience in orthopaedic surgery.[4]

Nowadays, treatment of adult patients with dental malposition and mastication impairment is one of the standard tasks of the orthodontist. If the discrepancies in spatial allocations of the upper and lower dentition are particularly pronounced and where the cause is primarily skeletal and not only dentoalveolar, conventional orthodontic therapy is limited and combined orthodontic-surgical therapy is indicated for remodelling of the jaw bases.

Treatment for a skeletal dysgnathia (Class III) using combined orthodontic-maxillofacial surgical correction is discussed in this article.

_Chronological development of maxillofacial surgery of the mandible

The first orthodontic-maxillofacial surgical procedure on the mandible described in the literature was that of the American surgeon Hullihen in 1848.[13] This procedure was a segmental osteotomy of the anterior

mandible (a posterior shift [retrusion] of a protruding mandibular alveolar process, following a burn injury). Towards the end of the 19th century, the method of orthodontic-maxillofacial surgical correction of dysgnathias by surgical retrusion or protrusion of the mandible was revisited. Jaboulay[14] described resection of the *Processus condylaris* and Blair[4], osteotomy on the *Corpus mandibulae*. The continuity resection in the horizontal branch by Blair was the first surgical prognathism procedure. The patient first visited the dentist Whipple in St. Louis in 1891 and was then referred to the then most renowned orthodontist Dr Edward Hartley Angle[2], who ultimately recommended the surgical procedure mentioned above.

Six years later, the procedure in this osteotomy on the *Corpus mandibulae* was also published by the Hamburg surgeon Floris.[11] Parallel with this development in the US, Von Auffenberg[3] in Europe conceived a step-by-step osteotomy for correcting a mandibular retrusion, which was performed by Von Eiselberg in 1901.

Figs. 3a–e_Clinical situation before the start of treatment.
Fig. 4_The cephalometric X-ray shows the disharmonious arrangement in the vertical axis. The lower face shows an approx. 60 per cent enlargement in relation to the upper face.


Fig. 3a


Fig. 3b


Fig. 3c


Fig. 3d


Fig. 3e

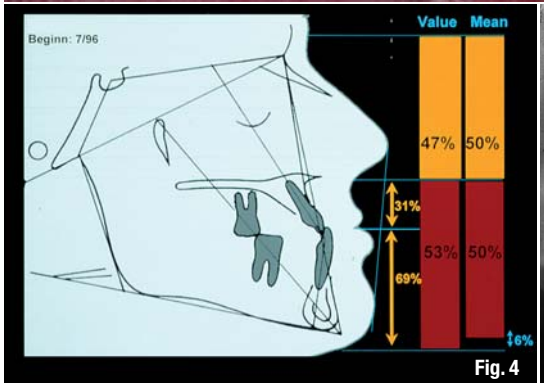

Fig. 4


Fig. 5

Fig. 5_Orthopantomographic image before the start of orthodontic treatment. An apical lucency at tooth 31. Pronounced maxillary-antrum expansion between teeth 25 and 27. Orthodontic closure of the gap is difficult.
Figs. 6a–c_Situation after orthodontic preparation for the surgical procedure.
Figs. 7a–e_Occlusion at the end of treatment; there is a neutral stable occlusion with physiological anterior bite in the sagittal and vertical axes and a correct midline (a–c). Monitoring images of the upper and lower jaws. A ceramic bridge was made in the lower jaw (d & e).


Fig. 6a


Fig. 6b


Fig. 6c


Fig. 7a


Fig. 7b


Fig. 7c


Fig. 7d


Fig. 7e

The era of orthodontic surgery in Europe began only after World War I. The experience gained there led to a substantial extension of the indications for orthodontic-maxillofacial surgical procedures, as well as to the transferral of this surgical technique to the area of elective procedures.[5,6,16–18,24] In the early 1920s, Bruhn and Lindemann set transversal osteotomy of the *Ramus mandibulae* as the standard method at the time for the surgical correction of mandibular prognathism. This method, which continued to have many adherents well into the 1960s, is today known as the Bruhn–Lindemann procedure.[1,6,25,45]

In 1935, Wassmund, who saw its drawbacks in a possible dislocation of the proximal segment by the muscles inserted there, described a modification of the Bruhn–Lindemann surgical technique.[26] In the early 1950s, a new era in orthodontic surgery of the mandible was begun with Kazanjian's resumption[12,15,23] of the technique of transverse, oblique severing of the ascending ramus, first performed by Perthes in 1922.[22] Shuchard modified this method in 1954 by enlarging the bony insertion surface, and in 1955 Obwegeser introduced sagittal splitting at the horizontal ramus of the mandible. He shifted the buccal osteotomy line

_contact cosmetic dentistry

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obliquely from the last molar to the posterior margin of the jaw angle.[19–21] In 1959, Dal Pont moved this buccal osteotomy line from the last molar to the inferior margin of the mandible.[8,9] Since then, this method of sagittal split at the mandible has been called *sagittal split* according to Obwegeser–Dal Pont (Fig. 1). Epker[10] developed the incomplete *sagittal split* into a routine method.

_Clinical case presentation

History and diagnosis

A 25-year-old patient presented on his own initiative. He complained of functional (impairment of mastication and jaw joint pain) and aesthetic impairment (sunken face with facial asymmetry). He had undergone orthodontic treatment between the ages of 8 and 15 and reported pain in the area of the anterior mandible.

The lateral image showed a retrusive lower face inclined forward with mid-facial hypoplasia—regio infraorbitale—a flat upper lip and an elongated lower face compared with the mid-face—47% : 53% instead of 50% : 50%[29] (Table I; Fig. 2a). Owing to the negative sagittal overjet, there was a positive lower lip step. The frontal image shows mandibular deviation (laterognathia) to the right, which can be traced to growth asymmetry in the jaw (Fig. 2b). In addition, there was a Class III dysgnathia angle with conspicuous mandibular midline deviation to the right, frontal and right lateral crossbite, anterior mandibular labial tilt, and a steep anterior mandible. Tooth 26 had been missing for some time (Figs. 3a–e). FRS analysis (Table I & II) clearly shows the strongly sagittal and relatively weak vertical dysgnathia both in the soft-tissue profile and in the skeletal region. The parameters indicated a mesiobasal jaw relationship and a growth pattern with an anterior course: the vertical grouping of the soft-tissue profile showed a disharmony between the mid-face and the lower face (G'-Sn : Sn-Me'; 47% : 53%). This was relatively weakly expressed in the bony structures (N-Sna:Sna-Me; 44% : 56%). In the region of the lower face there was also mild disharmony (Sn-Stm : Stm-Me'; 31% : 69%). Complementary assessment of the mandible showed that the area from the *subnasal-labral inferius* to the soft-tissue chin (Li-Me'), which should have been 1 : 0.9, was shifted in favour of the Li-Me' part (0.9 : 1; Fig. 4).The panoramic image showed a lucency of teeth 31 and 41. A root canal procedure followed by root apex resection was thus performed (Fig. 5).

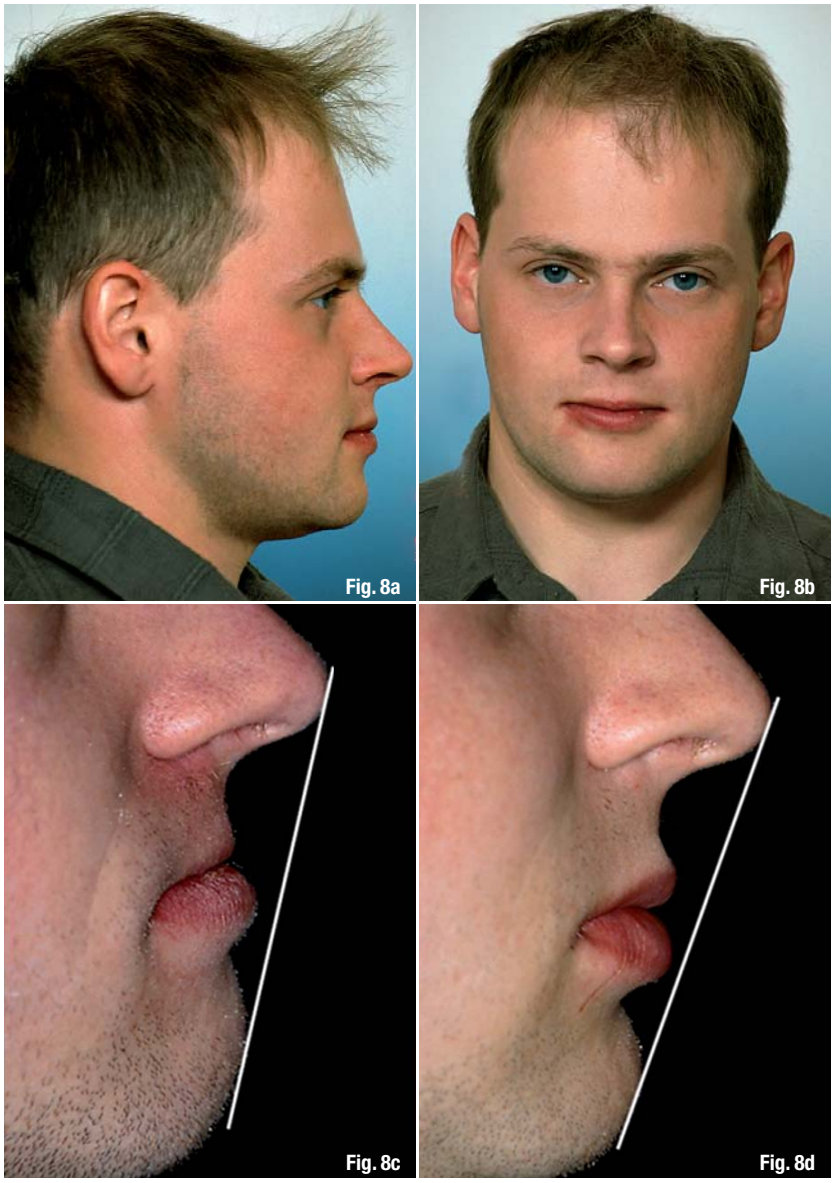
_Therapeutic objectives and treatment planning

The objectives of this combined orthodontic-maxillofacial surgical treatment were:

1. the establishment of neutral, stable, and functional occlusion with physiological condylar positioning;
2. the optimisation of the facial aesthetics;
3. the optimisation of the dental aesthetics, considering the periodontal situation;
4. the assurance of the stability of the results achieved;
5. meeting the patient's expectations.

The improvement of the facial aesthetics not only in the sagittal axis in the region of the lower face (the mandibular region), but also in the region of the mid-face (hypoplasia) and in the transverse axis should be noted as specific treatment objectives. The change in the region of the mid-face was intended to affect the upper lip and the upper-lip vermillion. These treatment objectives were achieved by two procedures:

1. a dorsal extension of the mandible with lateral sweep to the left for correction of the sagittal and transverse defects, as well as occlusion and the soft-tissue profile;
2. bone augmentation in the mid-face for harmonisation of the face. It would not have been possible to achieve



Figs. 8a–d_The extra-oral treatment results. The sagittal, vertical and transverse were corrected (a & b). Change in the oral profile: left pre-op, right post-op (c & d).

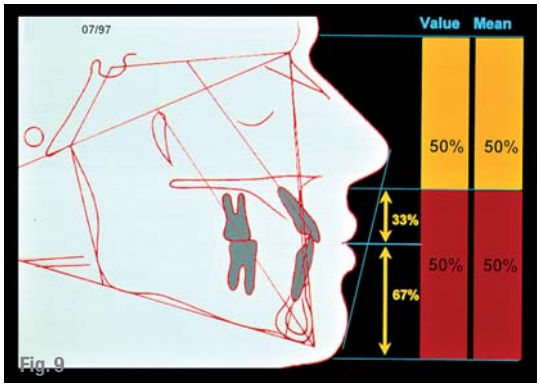


Fig. 9_The cephalometric image after conclusion of treatment shows a harmonious ratio between the skeletal structures, as well in the sagittal axis and the vertical axis, and harmonisation in the soft-tissue profile between the upper and lower face.

Fig. 10_Orthopantomogram after conclusion of the orthodontic treatment and before the prosthetic care.

Table 1_Proportions of soft-tissue structures before and after treatment.

Table 2_Proportions of skeletal structures before and after treatment.

the desired treatment objectives with respect to function and aesthetics using orthodontic procedures alone.[27]

Therapeutic procedure

Correction of the pronounced dysgnathia was done in six phases:[28,30–33]

1. Splint therapy: a flat bite guard splint was installed for six weeks in order to determine the physiological condylar position or centrics before the final treatment planning. By doing this, the forced bite could be demonstrated to its full extent.
2. Orthodontics for forming and adjusting the dental arches relative to each other and decompensation of the skeletal dysgnathia (Figs. 6a–c).
3. Splint therapy for determining the condylar position. This was performed in the 4 to 6 weeks prior to the surgical procedure. The objective was registration of the jaw joint in a physiological position (centrics).
4. Oral surgery for correction of the skeletal dysgnathia: after model operation, determination of the transposition path and production of the splint in the target occlusion, the surgical mandibular translocation using sagittal split according to Obwegeser–Dal Pont was done. Augmentation in the mid-facial region was done using autologous bone.
5. Orthodontics for fine adjustment of occlusion.
6. Retention: 3-3 retainers were cemented in the mandible.

Mandibular and maxillary plates were used as the retention appliance. Prosthetic care was provided after six months.

Parameter	Mean	Before treatment	After treatment
G'-Sn/G'-Me'	50 %	47 %	50 %
Sn-Me'/G'-Me'	50 %	53 %	50 %
Sn-Stm/Stm-Me'	33 % : 67 %	31 % : 69 %	33 % : 67 %
Sn-Li/Li-Me'	1 : 0.9	0.9 : 1	1 : 1

Table 1

Parameter	Mean	Before treatment	After treatment
SNA	82°	90°	90°
SNB	80°	93°	90°
ANB	2°	- 3° (indl. 4,5°)	0° (indl. 4,5°)
WITS-Wert	± 1 mm	- 8 mm	- 3 mm
ML-SNL	32°	20°	20°
NL-SNL	9°	4°	4°
ML-NL	23°	16°	16°
Gonion-<	130°	120°	120°
SN-Pg	81°	93°	90.5°
PFH/AFH	63 %	74 %	76 %
N-Sna /N-Me	45 %	44 %	44 %
Sna-Me /N-Me	55 %	56 %	56 %

Table 2

_Results

Figures 7a–e show the situation after the conclusion of treatment and after extraction of tooth 31 and subsequent prosthetic treatment, neutral occlusion, and correct midline with physiological sagittal and vertical bite. The extra-oral images show a harmonious profile in the vertical as well as in the sagittal axis (Figs. 8a & b). The oral profile is harmonious. The upper-lip vermillion is distinctly visible in comparison to the original situation (Figs. 8c & d).

The FRS shows the changes in the parameters that arose as the result of the displacement of the mandible. There is harmonisation in the vertical arrangement of the bony and soft-tissue profile. The disharmony in the lower third of the face has been corrected (Fig. 9; Tables 1 & 2).

The OPG shows the positioning screws in both jaw angles and the fixation screws of the augmented bone in the mid-face (Fig. 10)._

Editorial note: A complete list of references is available from the publisher.

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Fixed prosthodontic management of a mutilated dentition: A team approach

Authors_Dr Helena Lee & Dr Ansgar Cheng, Singapore

Fig. 1_Pre-treatment intra-oral frontal view, presenting with attrition, loss of posterior support, reduced VDO and compromised aesthetics.

_Abstract

_**Successful full mouth fixed** rehabilitation of a mutilated dentition is always a prosthodontic and surgical challenge. Accurate diagnosis, proper treatment planning, prudent choice of prosthodontic materials and meticulous treatment execution are essential for a successful treatment outcome over a long period. The treatment of a partially edentulous oral cavity using a combination of immediate-loading and delayed-loading implant-supported porcelain-fused-to-metal and full-ceramic restorations is presented in this report.

_Introduction

Prudent clinical judgement and careful balancing of the risks and benefits of various treatment options are essential for a predictable long-term treatment outcome for prosthodontic treatment.[1] It is known that loss of the vertical dimension of occlusion (VDO) may pose significant clinical difficulties in prosthodontic treatment.[2] The clinical procedures for the re-establishment of a new therapeutic vertical dimension of occlusion is seldom taught in undergraduate dental curricula. VDO is defined as the superior–inferior measurement between two points when the occluding elements are in contact.[3] Various methods have been proposed for the clinical assessment of the VDO.[4] Loss of the tooth structure does not necessarily equate to loss of the VDO,[5] as the VDO may be maintained as a result of compensatory dental eruption.[6] When the clinical loss of the VDO is small, accurate diagnosis can be difficult.[7] In this case study, the management objective was to determine whether there was any need for the re-


Fig. 2


Fig. 3

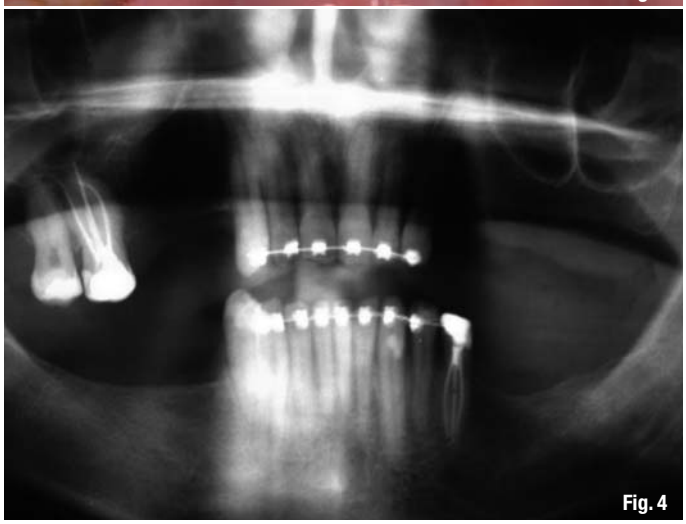
Fig. 4


Fig. 5

establishment of the VDO in the case of small loss and whether the proposed change in the VDO was clinically acceptable. When the loss of the VDO is small, any change in the VDO should be based on the amount of interocclusal space required to restore the dentition to proper form and function. A significant alteration of the VDO should be approached with care, and unnecessary, excessive changes of the VDO should be avoided. In general, a significant change of the VDO should be monitored over an extended period.[8]

Improvements in macroscopic implant morphology and surface treatments have led to the reduction of healing time and the concept of immediate loading of implants.[9–18] Early implant loading is a successful protocol in selected cases.[19–24] Providing that sufficient bone volume is available, flapless surgical implant placement is predictable[25, 26] and patients experience minimal post-surgical discomfort.[27]

The posterior maxilla presents a unique challenge to implant placement when minimal bone height remains inferior to the sinus floor. Pneumatisation of the maxillary sinus occurs after extraction of molars. In addition, the posterior maxilla has poorer bone quality, mainly Type IV bone.[28]

Placement of implants in grafted bone sites has a high success rate of osseointegation.[29–32] Several authors have reported an approximate 92 per cent success rate of implants after sinus augmentation.[33] However, immediate implant loading under such conditions is generally avoided. The low failure rate may be attributed to the placement of implants of greater lengths in grafted bone sites.[29, 30, 34]

This case study describes the team approach management of a mutilated dentition, using different types of conventional and implant-supported fixed restorations with immediate-loading and delayed-loading protocol.

_Clinical report

A 38-year-old patient presented with multiple missing teeth. The patient desired the restoration

Fig. 2_Pre-treatment intra-oral occlusal view of the maxilla, showing dental attrition and inadequately restored molars. The orthodontic arch wire was broken.
Fig. 3_Pre-treatment intra-oral occlusal view of the mandible, showing dental attrition and inadequately restored teeth. A few of the orthodontic brackets were de-bonded from the mandibular incisors.
Fig. 4_Pre-treatment orthopantomogram X-ray, showing adequate endodontic fillings, over-eruption of maxillary molars, inadequate occlusal support and inadequately restored teeth. Posterior mandible bone bed was diagnosed as Type 2B.
Fig. 5_Completed tooth preparations for full coverage restorations at the approximated treatment VDO. Note the equi-gingival preparation margins. Implants were placed immediately upon completion of crown preparations.

of function and aesthetics. He was undergoing orthodontic treatment. He presented clinically with moderate dental attrition, defective restorations, loss of posterior support, discolouration, mild loss of the VDO and compromised aesthetics (Figs. 1–3). The pre-treatment radiograph showed adequate endodontic obturation, missing mandibular posterior teeth, over-eruption of maxillary posterior teeth and attrition of the incisors. The dentition was free from active dental caries and periodontal probing was within normal limits. The maxillary left molar region bone bed was determined to be inadequate for the placement of dental implants. The mandibular posterior bone bed was diagnosed as Type 2B with sufficient bone density for early implant-loading prosthodontic treatment (Fig. 4).

The overall fixed prosthodontic treatment plan included placement of endosseous implants in the mandibular posterior area for prosthodontic rehabilitation, using the early implant-loading protocol; placement of fixed restorations in the maxilla and mandible; sinus lift with bone augmentation on the patient's left side; and simultaneous bilateral placement of implants in the maxillary posterior area, using the conventional two-stage protocol. This was followed by the placement of implant-supported prostheses in the maxilla after a healing period of six months.

Maxillary and mandibular diagnostic casts were made of Type IV dental stone (Silky-Rock, Whip Mix). The casts were mounted on a semi-adjustable articulator (Hanau, Wide-vue, Teledyne Waterpik). Diagnostic wax-up was carried out to restore the anterior teeth to proper form. The resulting diagnostic wax-up indicated that an increase of 1.0 mm in vertical dimension at the incisal pin level was required to restore the patient's anterior teeth to proper form. Such level of change of the VDO had no practical need for prolonged provisionalisation before definitive prosthodontic treatment. The patient's maxillary right second and third molars required a reduction of 2.5 mm gingivo-incisal height, in order to re-establish a proper occlusal plane. All the natural teeth in the maxillary and mandibular arches required full coverage restorations.

Fig. 6_Completed anterior full-ceramic crown restorations. Occlusal support was gained by definitive restorations on all the natural teeth and mandibular implant-supported prostheses to maintain the newly established VDO.

Fig. 7_Panoramic radiograph after insertion of the crowns. Additional implants were placed in the maxillary posterior areas.

Fig. 8_Occlusal view of completed definitive maxillary restorations with porcelain occlusal surfaces.

Fig. 9_Occlusal view of completed definitive mandibular restorations with porcelain occlusal surfaces.


Fig. 6


Fig. 7


Fig. 8

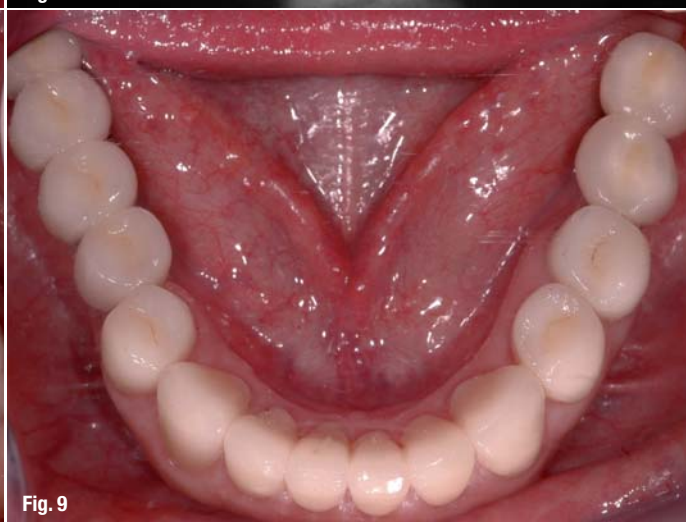
Fig. 9

Fig. 10_Post-treatment intra-oral frontal view.

The maxillary right second molar was restored with an amalgam post-and-core foundation prior to full coverage restoration preparation. An adequate pre-existing composite resin core retained by a prefabricated post with sufficient ferrule was noted in the mandibular left second premolar.

On the day of teeth preparation, all teeth were prepared to receive full crown restorations. In order to establish anterior guidance,[35] the treatment indicated that the restoration of the anterior teeth should be completed before or at the same time as the implant-supported restorations. The anterior teeth were prepared in the usual manner for complete coverage crown restorations. Margins of the tooth preparations were kept supra-gingival, and no gingival displacement procedures on the prepared teeth were necessary.

Upon completion of the crown preparations, six endosseous implants (NobelReplace, Nobel Biocare) were placed by the periodontist in the posterior mandible using a flapless surgical protocol. All implants were placed with 45 Ncm insertion torque (Fig. 5). No surgical template was used during the surgical phase; the prosthodontist was present during the implant surgery to ensure implant placement was prosthodontically acceptable.

Pick-up type implant impression copings (NobelReplace, Nobel Biocare) were attached to the newly placed mandibular implants. High-viscosity vinyl polysiloxane material (Aquasil Ultra Heavy, DENTSPLY DeTrey) was carefully injected onto all tooth preparations and the implant impression copings. A stock polystyrene tray loaded with putty material (Aquasil Putty, DENTSPLY DeTrey) was seated over the entire dental arch to make the definitive mandibular impression. The maxillary definitive impression was made in the usual manner. A centric relation record was made with a vinyl polysiloxane material (Regisil PB, DENTSPLY DeTrey).

The development of the definitive crown restorations was carried out as usual on the definitive casts. Except for the maxillary right molars, all maxillary and mandibular crowns supported by natural teeth were restored with Cercon (DeguDent) full-ceramic crowns. Prefabricated abutments (NobelReplace, Nobel Biocare) were custom milled with a six-degree taper in the dental laboratory to facilitate the development of the restorations. Splinted, cement-retained, implant-supported mandibular restorations with porcelain occlusal surfaces were made of porcelain fused to metal material.

On the day of restoration delivery, the mandibular implant abutments were torqued down to 32 Ncm. The abutment screw holes were sealed with gutta-percha (Mynol, Block Drug Company). All the definitive crowns were cemented in resin-modified glass-ionomer luting agent (RelyX Unicem, ESPE). The insertion of crowns was followed by implant placement in the maxillary arch.

In the presence of the prosthodontist, three endosseous implants (NobelReplace, Nobel Biocare) were placed by the periodontist in the right maxilla, using a flapless surgical protocol. The implants were inserted with 45 Ncm insertion torque. The implants were placed in the left maxilla with a simultaneous sinus lift (Figs. 6 & 7).

The sinus space was augmented with a xenograft material (Bioss, Geistlich Pharma).

After a six-month healing period, the left maxillary implants were exposed. A definitive maxillary impression was made as usual. The fabrication of the definitive porcelain-fused-to-metal implant-supported restorations was carried out in the usual manner on the definitive casts. Splinted, cement-retained, porcelain-fused-to-metal restorations with porcelain occlusal surfaces were prescribed for the implant-supported maxillary posterior crowns. The maxillary implant-supported restorations were inserted in the same manner described earlier using resin-modified glass-ionomer luting agent (RelyX Unicem, ESPE; Figs. 8 & 9).

_Discussion

Various newer implant clinical protocols and conventional two-stage delayed-loading implant protocols have a high level of clinical predictability. In this report, a flapless implant procedure, single-stage implant placement, sinus lift augmentation, and early implant-loading and delayed implant-loading techniques were applied.

The treatment required a small increase in the VDO. It was therefore necessary to make impressions that registered all tooth preparations simultaneously.

The patient desired a high level of aesthetics; full-ceramic restorations were chosen for the anterior teeth. As the minimum core thickness for this full-ceramic system is 0.4 mm, this enabled conservation of tooth structure while achieving excellent aesthetics.

Traditional porcelain-fused-to-metal anterior crown restorations require the placement of labial crown margins within the gingival sulcus, in order to mask the transition between the root surface and the porcelain-fused-to-metal restoration. By prescribing full-ceramic restorations, intrasulcular placement of crown margins on the labial surface becomes less important from an aesthetic standpoint.

In this report, the cervical tooth structure of the anterior teeth was free of caries, teeth preparation margins were made at the gingival level and gingival retraction procedures were eliminated. As gingival retraction cord packing was not required, mechanical trauma to the gingival tissues was reduced and significantly less clinical time was required. This is particularly beneficial for individuals with thin gingival biotypes.

Porcelain-fused-to-metal restorations were used in the posterior teeth because of the well-documented long-term clinical track record of this restoration. In order to maximise the aesthetic outcome, porcelain occlusal surfaces were prescribed.

_Conclusion

The clinical management of an aesthetically demanding, complex functional prosthodontic rehabilitation is a clinical challenge. Various restorative materials were used for this treatment. A combination of full-ceramic restorations and porcelain-fused-to-metal restorations with porcelain occlusal surfaces enhances the overall aesthetic outcome, as well as functional predictability. Various surgical and implant-loading protocols were used, to ensure optimal results._

Editorial note: A complete list of references is available from the publisher.

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cosmetic dentistry

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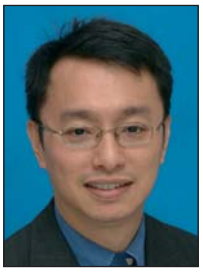

Dr Ansgar Cheng obtained his dental training from the University of Hong Kong, his prosthodontics specialty training from Northwestern University, USA, and his Certificate in Maxillofacial Prosthodontics from UCLA, USA. He is a Consultant Prosthodontist with Specialist Dental Group™ in Singapore.

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Replacement of a faulty posterior restoration

Author_ Dr Sushil Koirala, Nepal

_A 21-year-old male patient presented complaining of sensitivity and mild pain when chewing on tooth #36. During examination, an under filled tooth with poor marginal seal and marginal discoloration was visible. The peri-apical radiograph indicated secondary caries.

After careful removal of the faulty composite restoration, the cavity was treated with the fluoride-releasing bonding system Fl-Bond II and restored with Beautifil Flow as a base and Beautifil fluoride-releasing materials (all SHOFU). Effect colours were used on the occlusal surface to mimic the adjacent tooth.

The main challenges in this case were the removal of the faulty composite restoration with minimal intervention of the healthy tooth structure and the mimicking of the occlusal anatomy and proper shade._

Fig. 1_Poorly restored composite restoration on tooth 36.
Fig. 2_Cavity after careful removal of faulty restoration with diamond point #340s.


Fig. 1


Fig. 2

_contact cosmetic dentistry

VISA Vedic Institute of Smile Aesthetics

Dr Sushil Koirala, VISA president, can be reached at skoirala@wlink.com.np.


Fig. 3


Fig. 4

Fig. 3_Isolation of tooth 36 with rubber dam.
Fig. 4_Application of self-etching primer on the entire cavity.


Fig. 5


Fig. 6

Fig. 5_Uniform application of bonding agent and subsequent light-curing.
Fig. 6_Application of a thin layer of flowable resin on the cavity floor.


Fig. 7


Fig. 8

Fig. 7_Application of flowable opaque (#UO) to mask the discolouration.
Fig. 8_Build-up of the dentin layer, obtaining occlusal anatomy.

Fig. 9_Build-up of the enamel layer and carving of the pits and fissures to achieve natural anatomy.
Fig. 10_Application of dark brown stain on the pits and fissures to match adjacent tooth 7, and light-curing.

Fig. 11_Checking the occlusal contact with articulating paper.
Fig. 12_Reduction of the high points with Dura White Stone #FL2.

Fig. 13_Note the restored anatomy comparable to natural adjacent tooth.
Fig. 14_Restoration after finishing and polishing.

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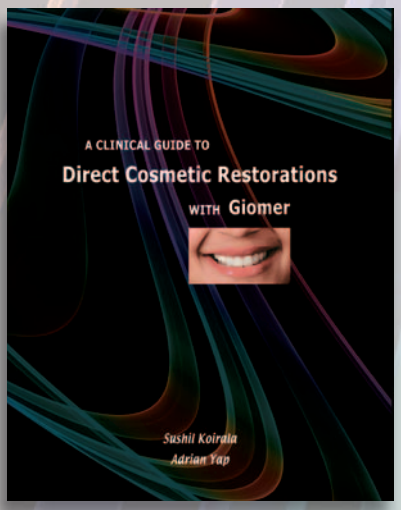
Dr. Sushil Koirala & Dr. Adrian Yap



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Simplified digital impression-taking

Author_ Dr Helmut Götte, Germany

_As the only system in the world that uses the principle of triangulation for intra-oral measurements, the CEREC system is setting higher standards in CAD/DAM technology with CEREC AC and the CEREC Bluecam camera. Never before have intra-oral scans been made as fast, sharp, or accurately in 3-D. Whole-jaw images broaden the indication spectrum and, with virtual models, allow the dental office and the dental laboratory to work together impression-free.

The acquisition unit of the CEREC 3D system—called CEREC AC (acquisition center)—has been equipped with a new camera (Bluecam). CEREC AC replaces the previous CEREC 3 acquisition unit; however, the new software still supports the CEREC 3 camera. CEREC AC is compatible with both milling units—CEREC 3 milling unit and CEREC MC XL (extra large).

The advantages of an improved intra-oral image-capturing system do not stop at producing larger restorations chairside. The simplified inclusion of the adjacent teeth and the opposing jaw makes it possible to improve the occlusal and functional design, and the more exact measurement of the preparation enables an increase in the information content of the image. Furthermore, intra-orally recorded 3-D data sets of gnathic situations offer new diagnostic possibilities.

The heart of CEREC AC is the Bluecam camera. Instead of infrared light, Bluecam emits short-wave blue light produced by diodes. In addition, the lens configuration is new: aspherical lenses bundle the light beam and orient it parallel to the image sensor (CCD). The light sensitivity has been increased, the image capture time shortened by 50 per cent, and the image sequence accelerated. The

Fig. 1_CEREC Bluecam Intra-oral Scanner. *(Image: Götte)*
Fig. 2_Quadrant scan with preparations, created from automatically joined individual images to yield a 3-D preview. *(Image: Götte)*


Fig. 1

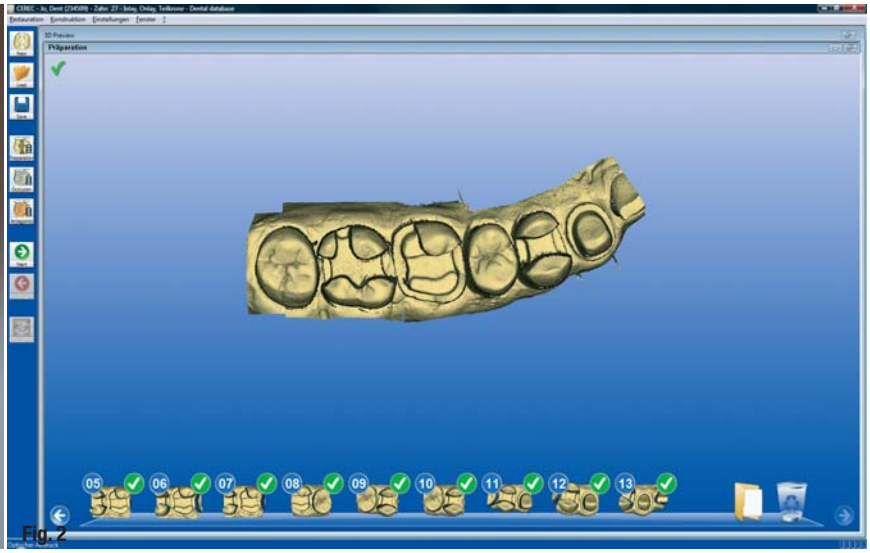

Fig. 2

projection matrix still employs the tried-and-tested light-stripe grid.

_Faster, sharper, blur-free

As a result, the new Bluecam offers higher image accuracy in the clinical situation: the measurement depth has been increased by 20 per cent and the focus depth deepened to 14 mm. The sharpness of individual images has been heightened, and marginal blurring eliminated. Blur control (automatic capture), the sensitivity of which can be pre-selected, checks the intended image, and the camera automatically takes the image only when it is certain there is no blurring. In quadrants and across the dental arch, any number of pictures can be taken as an overlapping sequence.

The 3-D image catalogue manages the individual images on the screen. The software assesses their usefulness, marks and rejects useless scans, and joins the images to form a complete row of teeth (matching) and a virtual cast modelled on the natural example. Images acquired at the beginning of the sequence, the quality of which may have been lessened owing to the presence of rubber dam or cotton rolls, are automatically exchanged for a suitable image pair as soon as this is found. In this way, inadequate images are quickly replaced. In vitro studies in the laboratory at the University of Zurich in Switzerland have shown that the image accuracy deviates from the reference measurement of a master laboratory scanner by only 19 µm—this is equivalent to one-third of the diameter of a human hair. This means Bluecam's accuracy is similar to that of stationary laser scanners. Such precision increases the marginal fitting accuracy of the restoration; thus, less excess occurs during adhesive luting, which in turn takes less time to remove.

Because of the image depth and focus depth, it is not necessary to keep an exactly determined distance from the preparation; the camera's prism window can be placed directly on the tooth, which makes image acquisition easier, particularly in the distal region. The Autocapture function, responsible for actually taking the image, engages automatically upon ensuring that the image is in focus. Hence, there is no need to operate a footswitch, which requires eye–foot coordination. This means that an entire quadrant can be scanned in 30 seconds. The blur control makes the image sequence and menu operation accurate and simple; thus, this phase can be delegated to the dental assistant. If the acquisition unit has a wireless or WLAN connection to the milling unit, the system can operate without power with no data loss for up to six minutes, thanks to its own optional, uninterrupted power supply—ideal for changing location during the milling/grinding phase.

_Up to four-unit bridges chairside

Bluecam takes about 30 seconds to scan a complete quadrant and is suitable for scanning stone casts. In addition, bite records with static and dynamic occlusion are digitised and prepared for functional articulation of the restoration. After selecting *bridge tooth databank*, the preparation for a four-unit bridge can be scanned with Bluecam. This enables the construction and chairside manufacture of long-term, provisional composite-resin restorations employing the CEREC milling unit, which broadens CEREC's indication spectrum considerably.

As when constructing crowns with CEREC 3D, fissure axes and cusps of the adjacent teeth are analysed—if desired, the antagonists' morphology is also analysed—and incorporated into the

Fig. 3_Crown restoration: adjusting the counterbite for occlusal surface design, region 24. *(Image: Götte)*

Fig. 4_Completing the crown's occlusal surface. *(Image: Götte)*

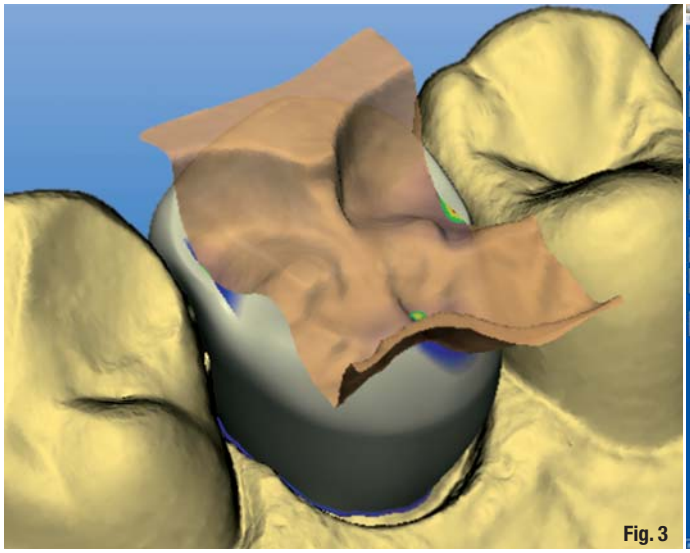

Fig. 3

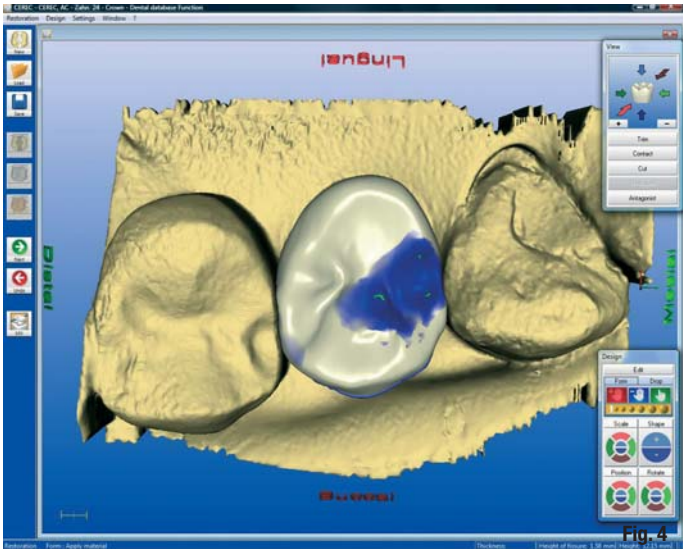

Fig. 4


Fig. 5


Fig. 6

Fig. 5_Crown 24 after adhesive insertion. *(Image: Götte)*

Fig. 6_CEREC AC showing Bluecam and Quadrant Scan. *(Image: Sirona)*

occlusal surface calculation. The software adjusts the occlusal contact points and sliding planes of the crown construction to the occlusal surface of the antagonist. The wall thickness of the projected ceramic framework is checked beforehand, as are the insertion paths of the abutment crowns. After designing the restoration, the data set can be transmitted to the milling unit or the practice's laboratory, or sent via LAN or wireless LAN to the dental laboratory. In the rapid milling mode of the CEREC MC XL milling unit, a four-unit bridge can be produced in about 20 minutes. Composite resin blocks by VITA (CAD-Temp) and Merz (artBloc Temp) can be used to fabricate the provisional restoration. The milling preview shows the size of the block required and the positioning of the restoration in the material—ideal when using ceramic blocks with integrated, density-determined enamel/dentine colour progression (VITA TriLuxe, Ivoclar Multishade).

_The virtual cast, online

Using the CEREC Connect system, the digital data of the optical impression, even of the whole jaw, can be sent from CEREC AC to the dental laboratory. This enables the cast-free manufacture of the restoration. In the future, it will be possible to manufacture a physical cast using these data from a portal, for dental laboratory use. In this manner, all single-tooth restorations could be manufactured, such as inlays, onlays, partial crowns, veneers, crowns and temporaries. For crown-and-bridge frameworks of up to four units, any dental laboratory lacking a CEREC milling unit will in the future be able to access the Internet portal infiniDent to have a cast manufactured, which will serve as the starting point from which the laboratory itself can manufacture the framework. Thus, CEREC AC and CEREC Connect together offer the smallest possible initiation into the CEREC system, which can be expanded upon to any extent desired. Every inLab laboratory can make use of this option to accept work from impression-free practices and manufacture all-ceramic crowns and bridges using CAD/CAM technology.

With the milling unit CEREC MC XL, the new CEREC 3D software and CEREC Connect, CEREC AC sets a new standard in restorative dental treatment. The system's ease of operation allows a constant and time-saving workflow in the dental office. The progressive technology also offers new opportunities for highly efficient cooperation with the dental laboratory. In addition, the modular nature of the CEREC system, its consistent development, and its total compatibility with all system components, including the labside system inLab, ensure complete treatment flexibility and sustainable investment security._

_author info

cosmetic dentistry

Dr Helmut Götte studied dentistry at the University of Munich were he graduated in 1993. Today, Dr Götte runs a fully digitalised, paperless dental office in Bickenbach, Germany. He has been using CEREC since 1996 and is a member of German Society of Computerized Dentistry.

Dr Götte can be reached at helmut.goette@goette-online.de

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The new NobelProcera system for clinical success: The next level of CAD/CAM dentistry

Authors_ Hans Geiselhöringer & Dr Stefan Holst, Germany

Fig. 1

Fig. 1_Modern materials combined with CAD/CAM technology present solutions for all clinical indications.

_Introduction

_While implant dentistry has broadened the range of treatment options available for patients, CAD/CAM technology is changing the restorative quality and concepts of the future. Advantages related to material and manufacturing will promote the continued preference of CAD/CAM systems to conventional casting techniques. The advantages new technologies offer include standardised quality guaranteed by industrial fabrication methods, excellent precision of fit, and outstanding biocompatibility, combined with adequate mechanical strength and provisions for aesthetic design. While there are many CAD/CAM systems on the market, only very few actually provide a broad range of products for different indications. The NobelProcera system advances digital dentistry to the next level in that it provides the ability to manufacture high-quality conventional restorations and implant-retained restorations from various materials.

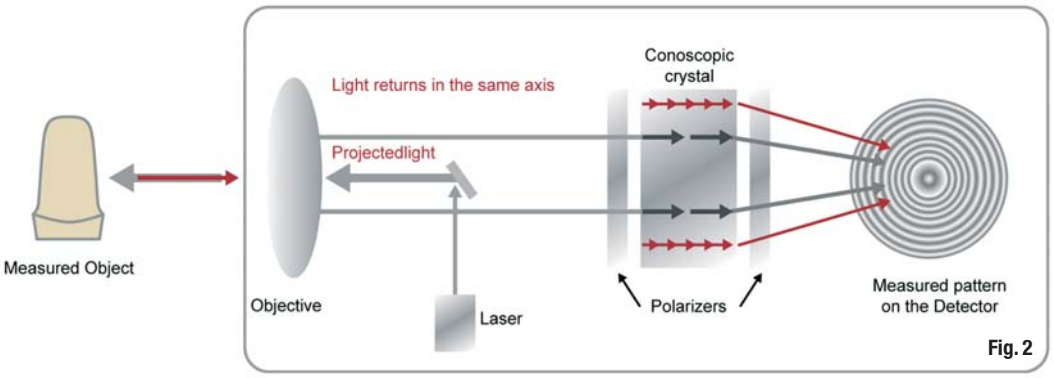


Fig. 2

Fig. 2_The working principle of a conoscopic laser scanner. The significant difference to conventionally used non-contact triangulation scanners is the co-linearity of the laser beam.

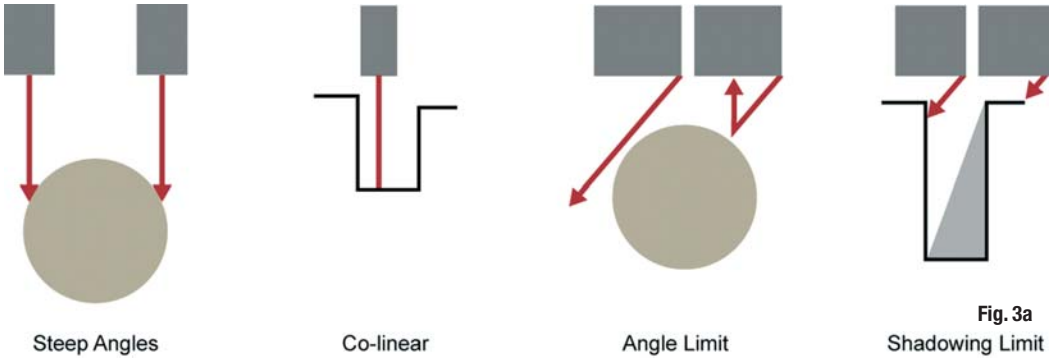


Fig. 3a

Fig. 3a_Schematic illustration of the conoscopic holography (left) and triangulation working principle (right).

The impact of advanced materials and manufacturing techniques on dentistry is significant. Owing to their many advantages, CAD/CAM technology and industrial fabrication of prosthetic components will replace several conventional laboratory fabrication processes in the future. Today, almost any clinical situation from conventional tooth-supported to implant-retained superstructures can be manufactured. This broad versatility and a guarantee of the highest quality material and precision of fit ensure reliable and safe solutions for any clinical indication irrespective of the type of finishing (Fig. 1). Moreover, industrialised fabrication methods reduce cost-intensive manual labour and provide cost-efficiency in the dental laboratory and practice.

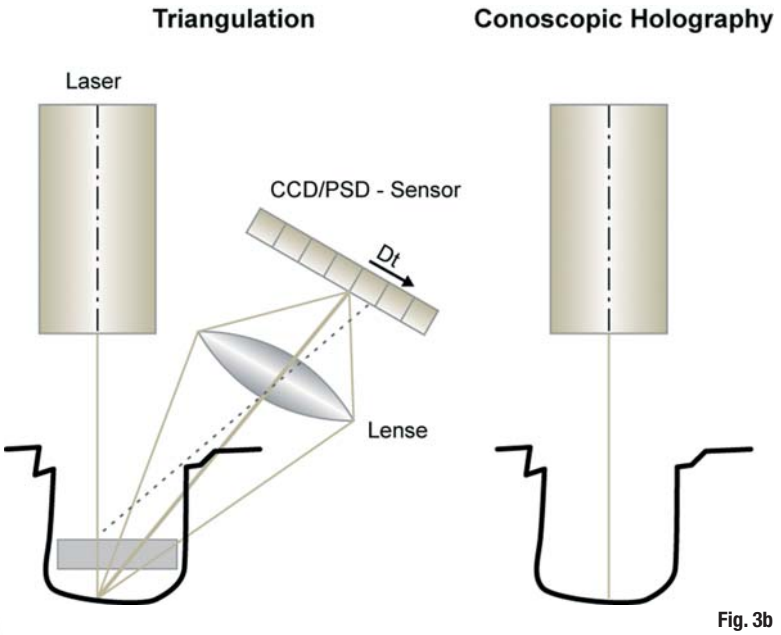


Fig. 3b

Fig. 3b_General set-up of triangulation scanners prevents scanning of deep cavities due to shadowing effects (left). Co-linearity of the beam in conoscopic holography (right) allows for scanning of deep cavities (e.g. impressions).

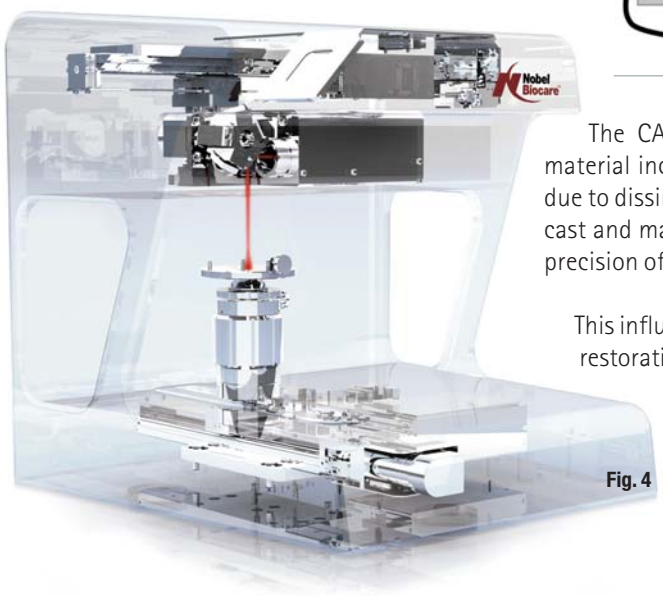


Fig. 4

Fig. 4_The new NobelProcera scanner (Nobel Biocare) based on conoscopic holography provides high accuracy for both impression-scanning and conventional cast-scanning.

The CAD/CAM system is able to minimise material incompatibilities, corrosive phenomena due to dissimilar metal alloys, interfaces between cast and machined components, and inadequate precision of fit.

This influences both the long-term success of a restoration and the aesthetic outcome. However, the predominant criteria for success are adequate treatment planning and the precise transfer of the intraoral situation into a digital data set.

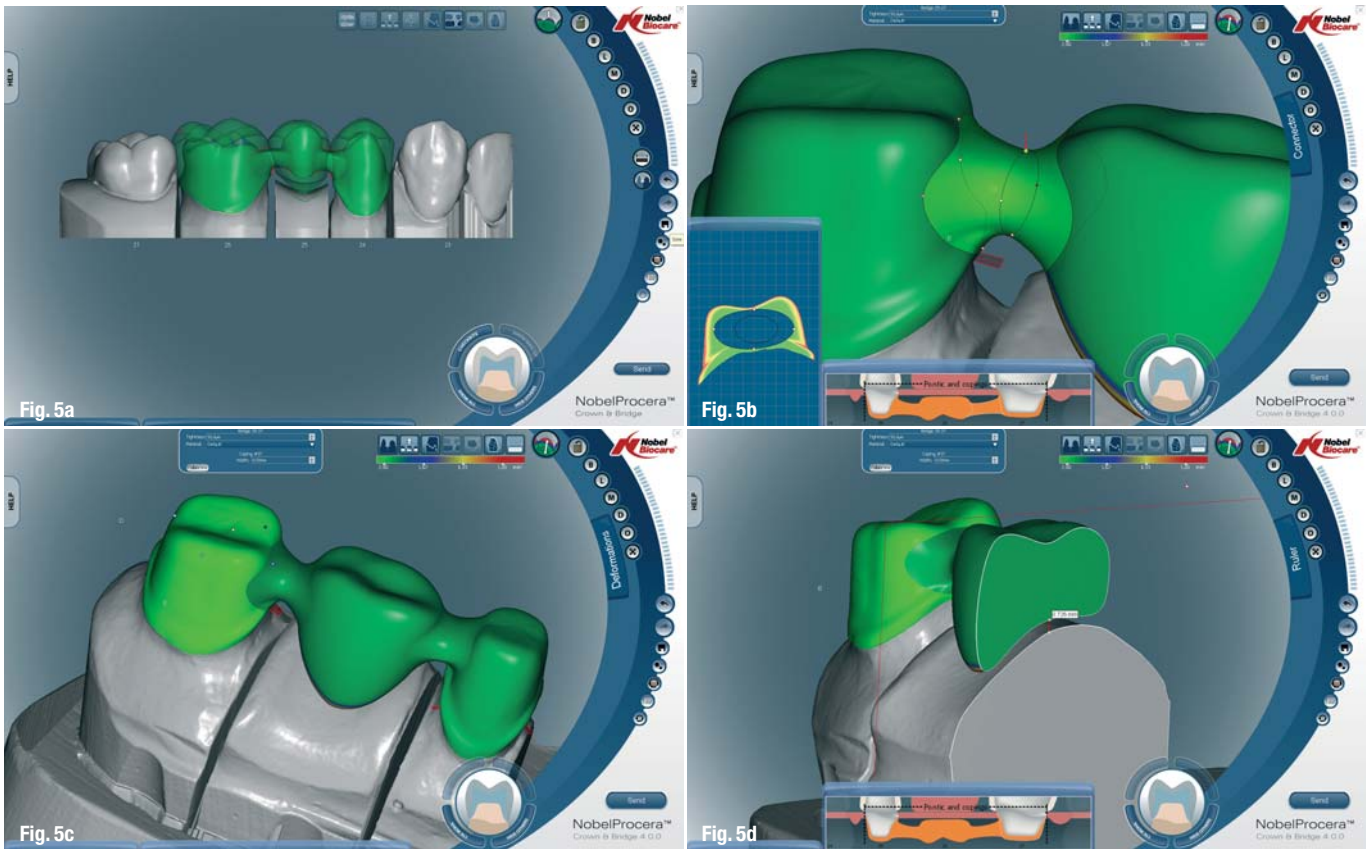


Fig. 5a_CAD/CAM technology allows virtual design of single- and multiple-unit frameworks (a NobelProcera software, Nobel Biocare).
Figs. 5b–d_Advanced software systems provide an additional margin of safety for the technician and the patient, as cross-sectional views allow for assessment of the correct framework dimension. As the connector area is the most critical aspect of long-term clinical success, special software features (NobelProcera software, Nobel Biocare) help to design the connector appropriately.

_Conoscopic holography: The next level in non-contact digitisation in dentistry

Currently the majority of scanners utilised in dentistry apply the triangulation principle. The configuration consists of two sensors (one a digital sensor and the other a camera or light-projector) observing the object. The triangulation sensor projects light onto the object, which is reflected back to a detector that is at an angle to the emitted light. The position of the illuminated pixel creates a triangle (light, object, detector) that allows the calculation of the distance from the sensor to the object. Owing to the working principle, this technique is adequate for scanning conventional dental casts predominantly. Although initial attempts to scan cavities were made, the general set-up has distinct limitations (shadowing effect). A variation of triangulation is structured light (projected fringes) projected onto the object. A camera, offset slightly from the pattern projector, looks at the shape of the light and uses a triangulation technique to calculate the distance of every point on the line.

An innovative technology introduced with the new NobelProcera non-contact scanner is conoscopic holography. The most significant difference to triangulation is the co-linearity of the laser beam: the light is emitted and reflected in the same axis, allowing for a whole new range of applications. In conoscopic holography—unlike triangulation—the measurement is not based on the geometry of the sensor and the system. Conoscopic holography creates a special fringe pattern and signals proportional to the distance from the object, and obtains a large amount of quality data reflected back from the surface, increasing measurement capability and precision. The scanner can digitise any convex (positive) or concave (negative) geometry that the laser beam is capable of 'seeing' with coverage of up to 240° (180° + 60° undercuts). This set-up combined with the co-linearity also allows for the scanning of impressions, eliminating a potential step for inaccuracies, such as model fabrication (Figs. 2–4).

_Ease of use and additional safety features with improved design software

In order to ensure efficient workflow, the digitisation and manufacture of components is needed, as well as a user-friendly software interface and intuitive handling.

Current scientific findings and clinical experience underscore the need for adequate material manufacture and framework design to minimise clinical failures, such as the chipping of veneering ceramics or fracture of frameworks. The most important request—especially when

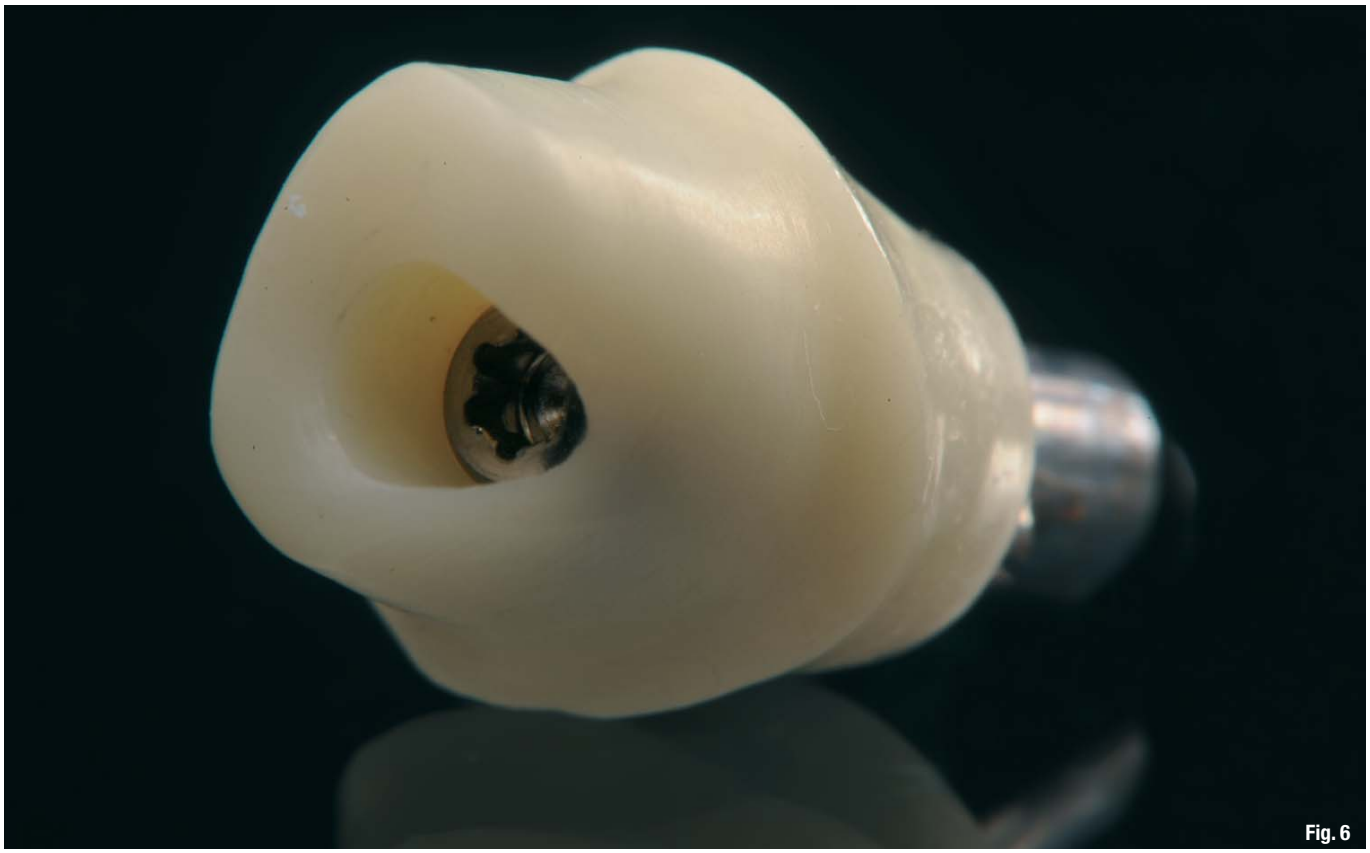


Fig. 6_In order to maximise aesthetic outcome, shaded zirconia abutments (NobelProcera Abutment Shaded zirconia, Nobel Biocare) can be combined with alumina or zirconia copings.

working with zirconia substructures—is that the framework is anatomically designed and no manual post-processing adjustments are needed. Previously, double-scans were performed to achieve this goal. However, with new software design tools, these time-consuming and cost-intensive steps are unnecessary, as 'anatomic tooth-libraries' support the user in optimal restoration and framework design. Automatic cutback functions increase the ease of use and provide an additional margin of safety by ensuring homogenous veneering material thickness.

An equally important aspect to consider is the design and dimension of the connector cross-section for fixed dental prostheses. Long-term clinical success is ensured only if minimum connector dimensions are respected. Newly developed software tools support the user in virtual design of the frameworks and provide immediate feedback on cross-sectional area, connector height and width, as well as coping thickness (Figs. 5a–d).

_Versatility for patients' demands and expectations: Material selection

A wide range of materials can be used in CAD/CAM manufacturing. Important aspects to consider include long-term stability in the oral cavity, biocompatibility, and post-processing options (for example, the type of veneering material).

Advancements in ceramic materials research have led to the development of high-strength, non-silica-based ceramics that have beneficial properties, including biocompatibility, aesthetics and long-term function. Aluminium oxide (Al_2O_3) and zirconium oxide (ZrO_2) ceramics are the most common materials for copings, FPD frameworks, and implant abutments. It is often wrongly assumed that CAD/CAM technology is only applicable to zirconium ceramics. Actually, CAD/CAM technology can be applied to a variety of materials. Aluminium oxide ceramics are the material of choice in aesthetically demanding areas, for example the anterior dentition, owing to their beneficial light optical properties.

In addition, the clinical applicability of Al_2O_3 in single-tooth and short-anterior FPD has been clinically proven, and Al_2O_3 surpasses zirconium in terms of long-term clinical success and aesthetic outcome. In contrast, for large-span and posterior restorations, yttria-stabilised zirconium dioxide (Y-TZP) is the material of choice. The material fracture strength properties of Y-TZP allow its application in any area of the oral cavity where strength and stability are more important than aesthetics. Additionally, the ma-

Fig. 7a

terial properties of zirconium make it a reliable alternative to cast alloys for implant-retained superstructures, including implant abutments and multi-unit implant-retained bridge frameworks. The availability of shaded zirconia is yet another step towards extensive and highly aesthetic solutions for the patient (Fig. 6).

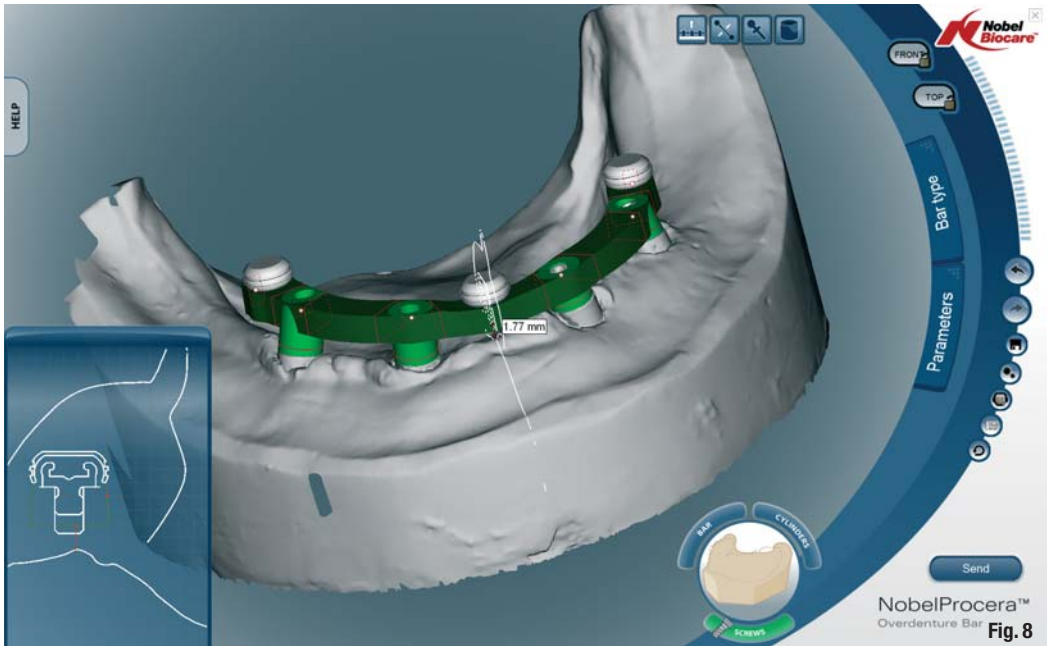
Alternative materials are titanium and non-precious alloys, such as Cobalt-chrome (CoCr). If centrally manufactured, these materials ensure excellent precision and long-term function in the oral cavity (Figs. 7a & b).

Additionally they may be applied whenever space requirements or expected biomechanical forces prohibit the use of ceramic materials or as long-term provisional restorations. With the new NobelProcera software, deciding on the appropriate material needs merely a click of a button.

_Clinical versatility through solutions for natural teeth and implants

A basic requirement of a modern CAD/CAM system is providing solutions for natural teeth and implants. In the future, implant-retained restorations for missing teeth will become the predominant form of restoration. The clinical


Fig. 7b



Figs. 7a & b_Industrial fabrication provides consistent product quality irrespective of material ordered, owing to material-specific milling and sintering strategies impossible in small units (Nobel Biocare production facility Tokyo, Japan).
Fig. 8_Screenshot of the design tool for implant-retained frameworks (NobelProcera software, Nobel Biocare). Cost-efficient workflow and high precision make this approach a very promising one for the future.

success rates, the high predictability and a reduction of costs, as well as the implementation of implantology in dental school curricula will lead to more frequent and earlier implant placement when a tooth is deemed non-restorable.

The abutment design and material to restore implant-retained single-tooth or implant-retained FPD restorations must fulfil some basic requirements. Today, multiple abutment types are available. Various studies have demonstrated the successful application of ceramic and titanium abutments in terms of acceptable soft-tissue and marginal bone stability.

A study examining different abutment materials and their influence on soft-tissue barriers surrounding dental implants found that the type of material used affected both the height and the quality of the tissue. Titanium and ceramic abutments permitted the formation of a mucosal attachment, while gold-alloy and metal-ceramic abutments led to soft-tissue recession and crestal bone resorption. Similar findings were observed through in vitro studies that validated the finding of reduced plaque and bacterial adhesion on titanium or zirconia abutments.

An indispensable factor of the long-term clinical success of implant-retained superstructures is the precision of fit. Depending on the complexity of a restoration, poor fit can have a significant impact on function and stability in the oral environment. When it comes to reproducible precision, CAD/CAM technology clearly outperforms conventional framework manufacturing techniques. New generation software tools eliminate the need for time-consuming framework design on the master cast. Instead, a scan of the implant position can easily be matched to a scan of a wax-up, followed by a virtual framework design in the CAD tool. Adjusting the design and dimensions according to the anticipated final contour of the definitive restoration is done in a few minutes instead of several hours with conventional fabrication protocols (Fig. 8).

Eliminating time-consuming and cost-intensive fabrication steps in the laboratory is not only beneficial for economic considerations, but also leads to an overall increase in precision and component quality through industrial manufacturing processes._

Editorial note: A complete list of references is available from the authors.

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Aesthetics with all-ceramics and tooth whitening

Author_ Dr Marcus Striegel, Germany


Fig. 1a

_Many dentists continue to have reservations about bleaching and are hesitant to include tooth whitening in the range of services they offer to their patients. At the same time, increasing numbers of patients are more aware of their teeth and tooth colour. Many people feel upset about their teeth not meeting their expectations of an ideal aesthetic appearance.

A smile that is marred by a dark anterior tooth can be restored to its natural beauty by means of a minimally invasive bleaching treatment in the dental practice—a treatment that is cost-effective and will leave most patients completely satisfied.

Surveys have shown that over 90 per cent of patients are highly satisfied with the results achieved by whitening discoloured or yellowish teeth with bleaching materials applied under the supervision of a dental professional. However, it is essential to have a thorough understanding of the aetiology of the discolouration and to adhere strictly to the indication guidelines regarding


Fig. 1b

the risks and limitations of bleaching, to ensure that the treatment provides safe and predictable results in practice.

_Case presentation

A young female patient presented with a request for a lighter tooth shade. Teeth 12, 11 and 21 had previously been restored with ceramic crowns. In the course of the patient's consultation, the need for replacing the existing crowns was discussed.

It is often advisable to commence the bleaching treatment in one jaw only, to demonstrate the outcome of the whitening process to the patient and align the treatment to the patient's expectations. This simple step soon raised the patient's enthusiasm for the treatment.

_How can I access the 'world of bleaching'?

Tooth whitening, using a deep-drawn tray and appropriate gels in the practice or at home, is an established bleaching method, even if this option is not quite as spectacular for the patient as bleaching with laser or UV-light. Deep-drawn trays are produced in a relatively straightforward procedure using thermoformable material on a stone model. It is worthwhile equipping the practice with a basic thermoforming unit, if you have not already done so. Various concentrations of carbamide peroxide preparations are available on the market. Higher concentrations provide faster results, but they involve the increased risk of reversible side effects, such as a burning sensation of the gums and hypersensitivities. It is important to provide the patient with clear guidance on how to apply the whitening gel.

According to the treatment plan, the upper jaw was first bleached using VivaStyle gel (Ivoclar Vivadent) containing 16 % carbamide peroxide and a tray. The patient wore the tray for one hour a day over a three-week period. In the course of the subsequent recall visit, she decided to extend the treatment to the lower jaw. Figures 2a and b show the teeth at the end of the bleaching treatment. Compared with the shade of the crowns on teeth 12, 11 and 21, the bleaching effect is clearly noticeable.

Normally, the degree of brightness achieved during the bleaching process will slightly decrease upon completion of the treatment. It is therefore necessary to wait at least two weeks before initiating any further treatments. In the present case, the existing crowns were replaced two months after completion of the whitening procedure.

Figures 3a to c show the prepared teeth. The original dentine shade contrasts with the shade of the adjacent bleached teeth. In this case, we did not have to forgo the aesthetic advantages of glass-ceramic materials, as special opaque ingots

Figs. 1a & b_Initial situation: tooth shade of the existing restoration (A3.5).
Figs. 2a & b_Tooth shade after the application of VivaStyle 16 % for three weeks. The shade of the natural teeth is clearly lighter than the shade of the existing restorations.
Figs. 3a–c_Prepared teeth and oral situation after cementation.
Fig. 4_Final situation.


Fig. 2a


Fig. 2b


Fig. 3a


Fig. 3b


Fig. 3c


Fig. 4

that are capable of masking the shade of the tooth preparation are now available. We decided to restore the teeth of our patient with IPS e.max Press (Ivoclar Vivadent) in combination with the veneering ceramic IPS e.max Ceram (Ivoclar Vivadent). This ceramic not only offers a variety of aesthetic possibilities, but can also be cemented using a conventional technique because of its high flexural strength. Whenever possible, we prefer using an adhesive cementation technique in conjunction with an aesthetic dual-curing luting composite. Variolink II (Ivoclar Vivadent) is a proven adhesive composite that has been used for many years in dental practice. The possibility of enhancing the shade effect of the final restoration by selecting an appropriate cement shade can be advantageous in some cases.

The result speaks for itself: the crowns harmoniously blend into the anterior region and complement the outcome of the treatment in terms of shade and shape.

_Conclusion

The whitening of discoloured tooth structure can be effectively integrated into a practice concept that helps patients to overcome their initial fear of dental treatment. As this type of treatment should always be performed under the supervision of a dental professional, patients are given a detailed consultation to establish their requirements prior to commencing the treatment. In the process, patients are made more aware of the range of prophylactic measures and high-quality dental treatments available to them. The combination of all-ceramic restoration and bleaching can form an aesthetic treatment strategy to enhance the smile of patients in a straightforward fashion with a high success rate._

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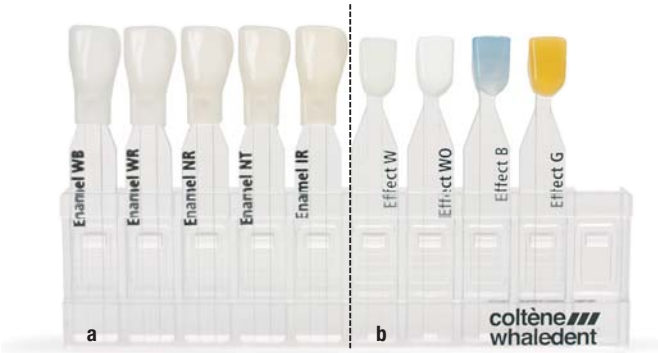
Learning and applying the Natural Layering Concept

Author_ Prof Didier Dietschi, Switzerland

Right_Dentine samples of the Miris 2 system, developed according to the NLC. Dentine samples all have the same hue but different chroma levels.
Below_Enamel samples and effect shades of the Miris 2 system. There are three tints (white, neutral and ivory) with different translucency levels and high opalescence that allow for an optimal imitation of natural enamel optical effects and behaviour (a). Two different white effect masses plus light, opalescent blue and gold shades allow the replication of specific colour effects, such as localised opalescence, enamel hypocalcification and dentine sclerosis (b).

_Composite resins nowadays occupy a paramount position among restorative materials because they offer excellent aesthetic potential and acceptable longevity, with a much lower cost than equivalent ceramic restorations for the treatment of both anterior and posterior teeth.[9,11–13] In addition, composite restorations allow for minimally invasive preparations or no preparation at all when replacing decayed or missing tissues. This approach is part of a new concept termed bio-aesthetics that gives priority to non-restorative or additive procedures, such as bleaching, micro-abrasion, enamel re-contouring, direct composite resins, bonded bridges, and implants, in the case of missing dental units or cases that are more complex. These many procedures definitely merit further attention because they offer tremendous improvements in practicability, efficiency and predictability.[2,8,10,11,14,15,17] All together, bio-aesthetics undoubtedly moves aesthetic and restorative dentistry to a new level; one that can be described as comprehensive and conservative smile design.



For quite some time, the creation of perfect direct restorations has been an elusive goal because of the imperfect optical properties of composite resins and perfectible clinical procedures. The attempt to mimic the shades and layering techniques developed for ceramic restorations led to complicated application methods, controllable only by highly skilled practitioners. For years, this has limited the number of patients who could benefit from the tremendous advantage of free-hand bonding. The use of the natural tooth as a model and the identification of respective dentine and enamel optical characteristics (tristimulus L*a*b* colour measurements and contrast ratio) have been essential in developing better direct tooth-coloured materials.[1,3,4]


Fig. 1a


Fig. 1b


Fig. 1c


Fig. 1d


Fig. 1e


Fig. 1f

The Natural Layering Concept (NLC) is a simple and effective approach to the creation of highly aesthetic direct restorations. The concept is increasingly referred to in the field of composite restorations; thus, the aim of this article is to familiarise the practitioner with the features and clinical aspects of this new technique.

_A new array of indications for free-hand bonding

Besides classical indications, such as the filling of Class III, IV and V cavities, many other aesthetic or functional problems can be addressed by simple direct composite restorations. The indications are as follows:

1) Congenital aesthetic deficiencies

Owing to the early preoccupation of patients with these aesthetic anomalies, a conservative aesthetic correction of these conditions is increasingly mandated (Figs. 1a–f):

_displasia/discolorations;
_hypoplasia;
_unsual tooth forms or dimensions; and
_diastemas.

2) Post-orthodontic conditions

Lateral incisor aplasia or incorrigible canine impactions are frequent findings, approached often with an orthodontic solution. Unfortunately, different anatomical, functional and aesthetic anomalies may result from such an orthodontic approach. Patients' increasing concern for aesthetics obliges the dental team to correct these deficiencies (Figs. 2a–h):

_unusual crown dimensions (larger or smaller);
_unusual root diameter (larger or smaller);
_unusual shape of the crown;
_difference in colour (mainly for cuspids); and
_difference in gingival contour or level.

3) Acquired and other aesthetic deficiencies

Many other aesthetic deficiencies in fairly intact dentitions also require conservative correction (Figs. 3a–e):

Fig. 1a_Pre-op view of a 50-year-old patient with natural arrangement of teeth following bilateral incisor aplasia.
Figs. 1b & c_Lateral views demonstrate the numerous aesthetic deficiencies, such as incorrect space distribution, tooth form proportions, axis and abrasion.
Figs. 1d & e_Post-op view of reconstructed smile following bleaching and the use of additive procedures.
Fig. 1f_The 4.5 years post-op view shows the good behaviour of these restorations and illustrates the potential of conservative adhesive dentistry to resolve relatively complex aesthetic cases.

Figs. 2a–c_Smile of a 30-year-old patient showing aged and unaesthetic composite reconstructions of canines, following lateral incisor aplasia.
Fig. 2d_A rubber dam is in place from premolar to premolar to allow for a full smile view and comprehensive correction of the six front teeth.
Figs. 2e–h_The post-op views show the final conservative smile rehabilitation, using direct bonding to re-establish better tooth proportions and forms (enlargement of central incisors, reshaping of lateral incisors and premolars).

_discolourations (i.e. traumatised non-vital tooth);
_diastemas;
_abrasion, abfraction and erosion lesions;
_tooth fractures;
_caries; and
_functional deficiencies.

All aforementioned conditions are potential indications for conservative additive treatments, according to pre-existing tissue loss and functional status.

_A new shading concept

The use of the natural tooth as a model was a logical development of direct restorative materials that led to the simplified shading and layering concept, the NLC. It is based on the identification of true dentine and enamel optical characteristics using tristimulus L*a*b* colour and contrast ratio measurements.[1,3,4]

Dentine replacement

The aforementioned measurements led to the following recommendations regarding the optical characteristics of an ideal material aimed at replacing dentine:

_single hue;
_single opacity; and
_large chroma scale (beyond the four chroma levels of the VITA system)


Fig. 3a


Fig. 3b


Fig. 3c


Fig. 3d


Fig. 3e

Fig. 3a_Young adult presenting hypoplasia of numerous front teeth. Some lesions were previously restored with an incorrect direct composite technique.
Figs. 3b & c_Teeth were bleached before initiation of a new restorative phase. The previous composite material was first removed to expose underlying sound tissue.
Figs. 3d & e_Better tooth shape and colour integration could be achieved through a simplified and improved direct restorative technique (NLC) and Miris 2.

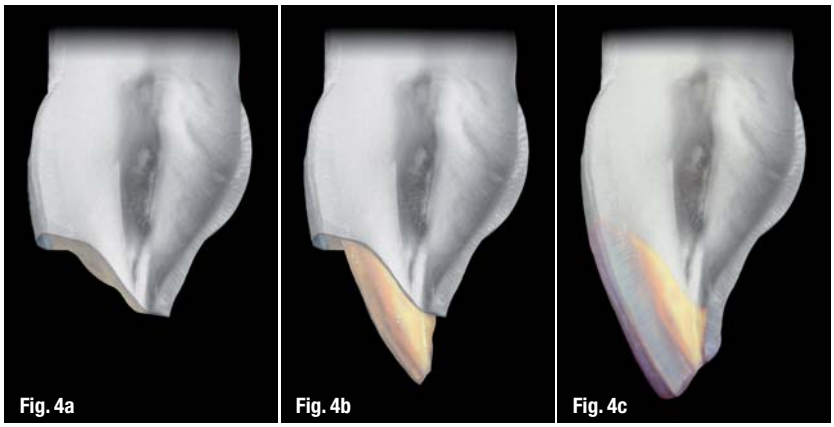
Actually, variations in a* and b* dentine values between 'A' and 'B' VITA shades seemed not to justify the use of distinct dentine colours, at least for a direct composite restorative system. Likewise, the variations of the contrast ratio (opacity–translucency) within a single shade group did not support the use of different dentine opacities (i.e. translucent, regular or opaque dentine). However, the concept of a large chroma scale covering all variations of natural dentitions plus some specific conditions like sclerotic dentine (as found underneath decays, fillings or cervical lesions) proved justified.

Enamel replacement

Concerning enamel, differences in tissue lightness and translucency proved generally to vary with tooth age. This confirmed the clinical concept of three specific enamel types:[16]

_Young enamel: White tint, high opalescence, lower translucency;
_Adult enamel: Neutral tint, lower opalescence, intermediate translucency; and
_Old enamel: Yellow tint, higher translucency.

These findings have logically fashioned the concept of an optimal restorative material. Dentine shades should be available in one single hue (VITA 'A' or Universal dentine shade) with a sufficient range of chroma (covering at least the existing VITA shade range) and presenting opacity similar to that of natural dentine. Enamel shades should present



Figs. 4a–c_*The centrifugal technique:* Post-preparation (a). The first layer is the dentine increment, placed in the depth of the preparation (b). The second layer is the enamel increment, creating the restoration surface (c).

Fig. 4d–g_*The bucco-lingual technique:* for optimal 3-D control of complex build-ups: Post-preparation (d). The first layer is an enamel increment, placed into the silicone index (e). The second increment is the dentine, placed buccally onto the previous enamel layer (f). The third layer is composed of additional enamel increments, creating the restoration surface (g).

Figs. 5a–c_The maturation of tissues influences incisal edge anatomy. Young tooth configuration: The dentine core that has a low chroma is fully covered with a white, opalescent enamel (a). Adult tooth configuration: The dentine core with medium chroma is usually covered with a more neutral, opalescent enamel. Dentine extends close to, or is even exposed at, the incisal edge (b). Old tooth configuration: The dentine core with higher chroma is covered with a thinner, more yellow and translucent opalescent enamel. Dentine extends to the incisal edge (c).

various tints and opacity levels, tentatively replicating all variations found in nature. Well-known brand names include Miris and Miris 2 (Coltène Whaledent), Ceram-X duo (Dentsply) and Enamel HFO (Micerium).

The influence of the Natural Layering Concept on shade recording

The quality of the final restoration depends on correct shade evaluation. According to the NLC, there are only two basic steps involved: The selection of the dentine chroma in the cervical area, where enamel is the thinnest, using samples of the composite material; and the selection of the enamel tint, often performed by simple visual observation.

With the special Miris and Miris 2 shading systems, each combination of dentine and enamel shades can be evaluated and compared to reference teeth, so that the risk of incorrect shade selection and aesthetic outcome is minimised. In specific and less frequent cases, a third step might be involved in the form of a visual or photographic mapping of the tooth special optical effects (such as white hypocalcification, high opalescence areas or areas with a higher chroma). In this situation, the application of effect materials, such as white, blue or orange-gold (i.e. Miris Effects, Coltène Whaledent), may be recommended.

_Clinical application of the Natural Layering Concept

Composites can be applied by following different incremental techniques for aesthetic or practical reasons and better management of polymerisation stresses. The classical approach is the centrifugal technique, indicated for Class III, small Class IV, and limited form corrections (Figs. 4a–c). It implies the placement in depth of one or two dentine layers (in Class III cavities, 01 with oblique position),[6] followed by the enamel, covering the entire surface.

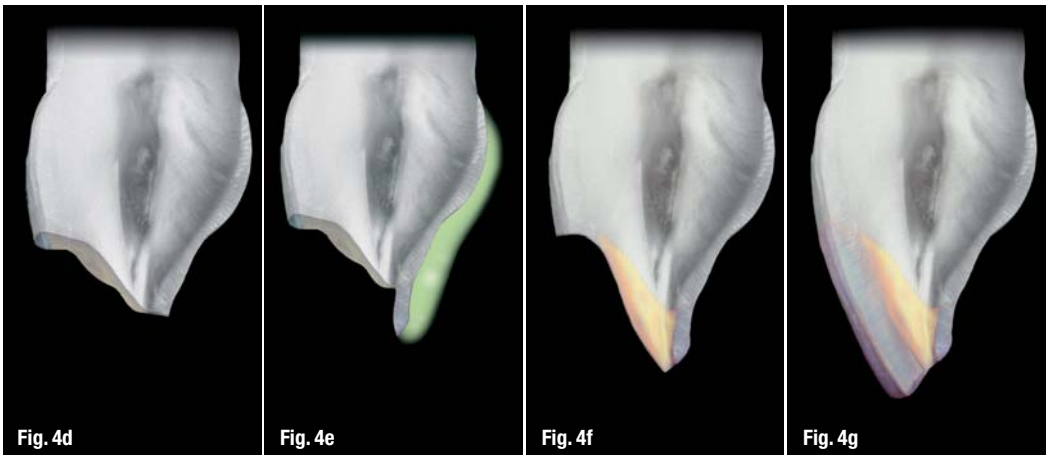
Another commonly used incremental approach is the bucco-lingual technique (Figs. 4d–g).[5–7] It makes use of a silicone key made from either a free-hand mock-up (simple cases) or wax-up (advanced cases). The first layer of enamel is placed directly on the silicone key, so that it provides the lingual profile, width and position of the incisal edge of the future restoration in one step. Thereafter, dentine and effect materials (when needed) can be applied in a precise 3-D configuration. This provides the conditions for an optimal aesthetic result, as well as translucency, opalescence and halo effects.

The effect of tooth ageing on dentine and enamel optical properties

Special attention has to be paid to the morphological changes that affect the incisal edge structure due to tissue ageing and functional wear. Actually, in addition to the increase in dentine chroma and enamel translucency, the progressive thinning of the enamel layer and exposure of dentine at the incisal edge necessitates an adaptation of the layering technique (Figs. 5a–c).[7]

_A new learning experience at the Geneva Smile Center

The Geneva Smile Center (GSC) strives for excellence in teaching comprehensive and conservative smile design and tooth-coloured posterior



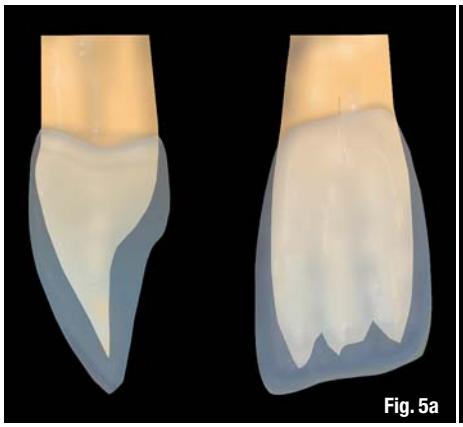


Fig. 5a


Fig. 5b

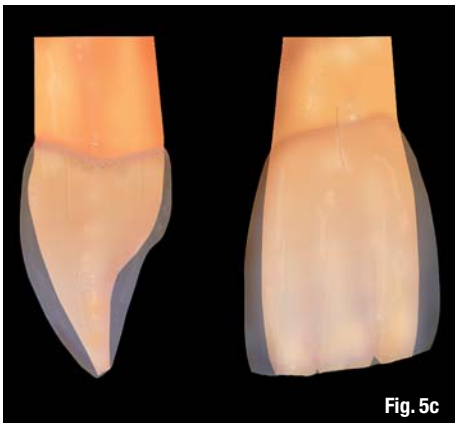


Fig. 5c

restorations (Figs. 6a–c). The three programmes offered thus far cover adhesive, aesthetic anterior and posterior direct and indirect restorations. The anterior programme consists of two courses run over three days (advanced and master levels), while the comprehensive posterior programme is run over three days.

All courses include well-balanced theoretical and hands-on components, which provide participants with the necessary scientific evidence to support clinical decisions and procedures and with ample time to practise the different procedures, leading to expertise in a developing field of dentistry. Dentists are spoilt today with a vast choice of procedures and products; therefore, it is essential to analyse the results of clinical studies and identify those options that guarantee long-term success. Translating complex and abundant in vitro and in vivo research data into clinical essentials has become one of the major assets of the education programme amongst the GSC programmes, next to the unsurpassed quality of practical teaching.

Another important aspect of these programmes is the focus on precision. The use of Zeiss microscopes, installed at each working station, helps participants to work with better vision and optimal precision, which is the key to success in aesthetic restorations and easier application of all kinds of adhesive procedures. Magnification lenses are also available for trial. These tools are of great help in the context of such courses, even though microscopes are not mandatory for routine treatments in restorative dentistry. There is also a great emphasis placed on individualised teaching, and the programmes at the GSC provide plenty of time to interact directly with course instructors. This is the reason that courses are organised for small groups with a maximum of 20 participants.

It is likely that the present economical situation or 'crisis' will also affect our profession. If it could ever have a 'positive' effect for us, this might be in the form of patients becoming more discriminative in their search for aesthetic treatments. We can

Figs. 6a–c_Education infrastructure at the GSC. Lecture room (a) and workshop room with dedicated microscopes and audiovisual network (b & c). The participants follow demonstrations and other presentations on their individual screens.


Fig. 6a

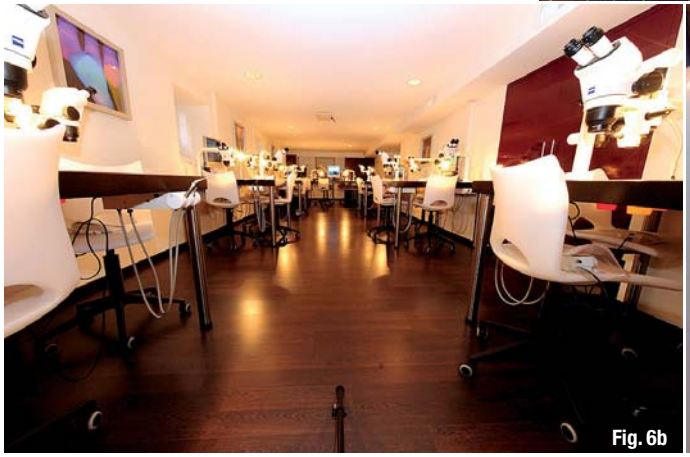


Fig. 6b


Fig. 6c

therefore expect that patients and dentists will better understand the tremendous advantage of non-invasive techniques, which can not only fulfil many of our aesthetic needs, but will also contribute to better preserving patient dental capital.

The vision at the GSC is to share knowledge and 25 years of clinical expertise with colleagues from around the world and to improve and facilitate their existing operation protocols, as well as instrument and product selection, and ultimately to help them achieve the highest level of aesthetics and precision in restorative dentistry.

_Conclusion

Traditional restorative objectives have not changed over time; rather, the implementation of restoratives has been based on the aesthetic demands of an increasing number of patients. Composite resins, which require a strictly conservative approach, have thus become the materials of choice for young patients and less privileged people. The contemporary practitioner is ultimately challenged to replace the missing tissues or eventually modify their configuration, by applying an artificial material to the patient's teeth, which has to simulate the appearance of natural tissues. The NLC has enabled this objective to be achieved in a predictable way, by incorporating newly acquired knowledge about natural tissue optical properties into contemporary composite systems. This advance can be regarded as a milestone in operative dentistry, as it will contribute tremendously to direct composite application, helping a larger number of our patients to receive aesthetic restorations that are more conservative.

Further information, including studies for Miris 2, is available at www.coltenewhaledent.com. For online education possibilities please visit www.globalinstituteonline.com._

Editorial note: A complete list of references is available from the publisher

Dr Didier Dietschi lecture events 2009–2010

2009

08–09 May	Patricia, Bulgaria
15–16 May	Coltène Whaledent, Altstätten, Switzerland
28–30 May	EAED, Gleneagles, Scotland
12–13 June	International Comprehensive Care Symposium, Cleveland, OH, USA
24–27 June	SBOE, Brazil
24–26 September	Dentart seminars/UDA Poltava, Ukraine
16–17 October	Coltène Whaledent, London, UK
24 October	CIDAE, Brussels, Belgium
02–03 November	Coltène Whaledent, Buenos Aires, Argentina
04–05 November	Coltène Whaledent, Santiago, Chile
08–11 November	IDEA San Francisco, CA, USA

2010

16 January	Arbeitskreis Kempten, Kempten, Germany
23 January	BSOS, Leeds, UK
03–06 February	Geneva Smile Center, Geneva, Switzerland
12–13 February	Coltène Whaledent, Altstätten, Switzerland
18–20 February	Geneva Smile Center, Geneva, Switzerland
04–10 March	CEO seminars – Gold Coast Australia
12–16 March	NZACD New Zealand
25–27 March	Geneva Smile Center, Geneva, Switzerland
15–21 April	Geneva Smile Center, Geneva, Switzerland
23–24 April	Coltène Whaledent (Dr L. Baratiori), Florianopolis, Brazil
14–16 May	AAAD Kuala Lumpur, Malaysia
27–29 May	EAED, London, UK
10–12 June	Geneva Smile Center, Geneva, Switzerland
25–26 June	Coltène Whaledent, Altstätten, Switzerland
03 September	Arbeitskreis Kempten, Kempten, Germany
24–25 September	Coltène Whaledent, Altstätten, Switzerland
14–16 October	Geneva Smile Center, Geneva, Switzerland
04–06 November	Geneva Smile Center, Geneva, Switzerland
12–13 November	Coltène Whaledent, Montreux, Switzerland
03 December	FGDP, Glasgow, UK

For more information and to register for Dr Dietschi's programmes, please visit www.edudentinternational.com

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_For the highest standards in aesthetic dentistry, Amaris Gingiva is the only restorative that permits chairside gingival shade matching. This new gingiva-shaded, composite-based restoration system facilitates individual shade matching using a combination of a base shade and three mixable opaque shades in white, light and dark. The result is a representation of the gingiva that appears natural. Through this technique, supported by proven Amaris expertise, extensively exposed cervical areas caused by gingival recession and wedge-shaped defects in the cervical area can be controlled in the future, both functionally and aesthetically. Amaris Gingiva extends the high standard of performance of modern composites to beyond the cervical boundary. This new material permits the reconstruction of the 'red–white' boundary with a predictable result.

_Suitable for multiple indications

Amaris Gingiva is also suitable for other indications. Reconstruction with gingiva-shaded composite thus represents an important extension of therapeutic measures following muco-gingival surgery. In addition, the 'black holes' induced by the loss of interdental papillae as a consequence of periodontitis or gingival recession can be quickly and easily treated with Amaris Gingiva to provide an aesthetic restoration. Amaris Gingiva can also be used to extend the lifespan of in situ crowns with visible and exposed edges caused by natural gingival shrinkage significantly.

_Outstanding material and handling properties

In addition to its material properties, Amaris Gingiva has impressive handling properties. It can be moulded extremely well and polished to a high gloss. Also, owing to the new non-drip, non-run NDT syringe from VOCO, applying the material is just as economical as it is hygienic. Amaris Gingiva has outstanding translucency and shade stability, exhibiting a very low shrinkage with a high filler content of 80 w/w % as a modern composite. It provides long-lasting, aesthetic restorations because of its low abrasion values, as well as its high compressive and transverse strength._

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11.3
11.2
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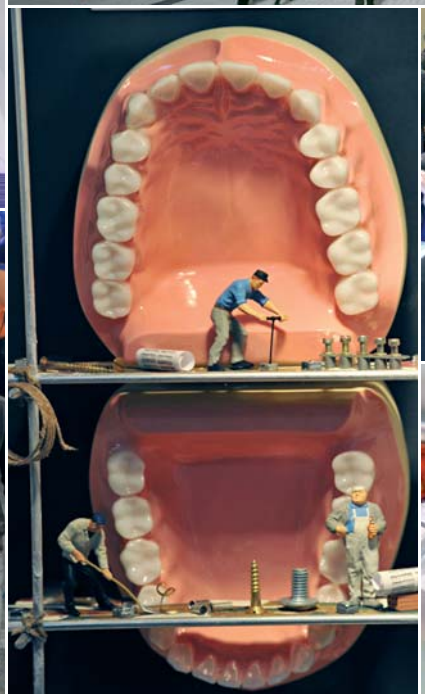
IDS
Köln · Cologne
24.–28.3.2009
33. Internationale Dental-Schau
33rd International Dental Show
IDS
2009
24. März: Fachhändlertag
March 24: Trade Dealer Day
VDDI
GFDI

koelnmesse



IDS flourishes despite economic trouble

Author_ Daniel Zimmermann, Germany
Photographs_ Koelnmesse

_The world's largest dental show has defied the economic gloom. According to a preliminary report released by the organiser Koelnmesse at the end of March, the number of visitors this year increased by 6.9 per cent to over 100,000. The number of exhibitors also rose by 4.5 per cent to 1,820. International companies held a 65 per cent share, an increase of 10 per cent compared with the previous show in 2007.

The results confirm a slight decline in the German domestic market, which is significant for the local dental industry. Sales have dropped by 2.6 per cent to €1.58 billion compared with 2007; this is attributed mainly to financial constraints in the dental and dental technology sectors in the last quarter of 2008. Although dental physicians are the group of medical specialists who are the most willing to invest in the establishment of clinics, according to the latest results of the Institute of German Dental Physicians (IDZ), the overall investment trend has fallen significantly.

However, a survey conducted by the Association of German Dental Manufacturers (VDDI) found that export business expectations for 2009 are positive overall in spite of varying business development in individual regions. VDDI Chairman, Dr Martin Rickert said that 83 per cent of the member companies surveyed expect a rise in, or at least consistent, overseas sales for 2009. The export quota of the companies traditionally operating as 'global players' is 57 per cent.

"It is good news that in spite of the turbulence in the financial market, the dental industry and the health economy can, overall, sustain as solid markets," Dr Rickert said during a press conference in Cologne. "IDS has confirmed its status as the international leading trade show in dentistry. We are certain that the show's outcome will give positive signals for the global dental market and international health markets as well," he added._

Cosmetic events

2009

EAED Spring Meeting
Where: Gleneagles, Scotland
Date: 28–30 May 2009
Tel.: +39 02 295 236 27
E-mail: info@eaed.org
Web site: www.eaed.org

2nd International Meeting by Dental Tribune Italian Edition
Where: Salerno, Italy
Date: 5–7 June 2009
Tel.: +39 39 39 34 00 44
E-mail: cosmeticmeeting@tueor.com

IACA Annual Meeting
Where: San Francisco, CA, USA
Date: 30 July–1 August 2009
Tel.: +1 866 669 4222
E-mail: info@theIACA.com
Web site: www.theiaca.com

AAED 34th Annual Meeting & IFED 6th World Congress
Where: Las Vegas, NV, USA
Date: 2–5 August 2009
Tel.: +1 312 981 6770
E-mail: meetings@estheticacademy.org
Web site: www.estheticacademy.org

FDI Annual World Dental Congress
Where: Singapore, Singapore
Date: 2–5 September 2009
Tel.: +33 450 4050 50
E-mail: congress@fdiworldental.org
Web site: www.fdiworldental.org

ACE 2009 Symposium on Esthetic Dentistry
Where: Scottsdale, AZ, USA
Date: 11–14 November 2009
Tel.: +1 80 07 01 62 23
E-mail: contact@ACEsthetics.com
Web site: www.acesthetics.com

SAAAD Aesthetic Dental Conference
Where: Kathmandu, Nepal
Date: 21–22 November 2009
Tel.: +977 142 425 64
E-mail: skoirala@wlink.com.np

Greater New York Dental Meeting
Where: New York, NY, USA
Date: 27 November–2 December 2009
Tel.: +1 212 398 6922
Web site: www.gnydm.org

2010

EAED Spring Meeting
Where: London, UK
Date: 27–29 May 2010
Tel.: +39 02 295 236 27
E-mail: info@eaed.org
Web site: www.eaed.org

AAED 35th Annual Meeting
Where: Kapalua, HI, USA
Date: 3–6 August 2010
E-mail: meetings@estheticacademy.org
Web site: www.estheticacademy.org

submissions:

formatting requirements

_Please note that all the textual elements of your submission:

_the complete article,
_all the figure captions,
_the complete literature list, and
_the contact info (bio, mailing address, E-mail address, etc.)

must be combined into one Word document. Please do not submit multiple files for each of these items.

In addition, images (tables, charts, photographs, etc.) must not be embedded into the Word document. All images must be submitted separately, and details about how to do this appear below.

Text length

Article lengths can vary greatly—from a mere 1,500 to 5,500 words—depending on the subject matter. Our approach is that if you need more or less words to do the topic justice then please make the article as long or as short as necessary.

We can run an extra long article in multiple parts, but this is usually discussing a subject matter where each part can stand alone because it contains so much information. In addition, we do run multi-part series on various topics.

In short, we do not want to limit you in terms of article length, so please use the word count above as a general guideline and if you have specific questions, please do not hesitate to contact us.

Text formatting

Please use single spacing and un-indented paragraphs for your text. Just place an extra blank line between paragraphs.

We also ask that you forego any special formatting beyond the use of italics and boldface, and make sure that all text is left justified.

If you would like to emphasize certain words within the text, please only use italics (do not use underlining or a larger font size). Boldface is reserved for article headers.

Please do not 'center' text on the page, add special tab stops, or use underling as all of this must be removed before layout. If you require a special layout, please let the word processing programme you are using help you to do this formatting rather than doing it by hand on your own.

If you need to make a list, or add footnotes or endnotes, please let the Word processing programme do it for you automatically. There are menus in every programme that will help you to do this. The fact is that no matter how careful one might be, errors have a way of creeping in when you try to hand number footnotes and literature lists.

Image requirements

Please number images consecutively throughout the article by using a new number for each image. If it is imperative that certain images are grouped together, then use lowercase letters to designate the images in a group (ie, 2a, 2b, 2c).

Please put figure references in your article wherever they are appropriate, whether that is in the middle or end of a sentence. If you are not directly mentioning the figure in the body of your article, when it appears at the end of the sentence the figure reference should be enclosed within parenthesis and be inside the sentence, meaning before the period.

In addition, please note:

_We require images in TIF or JPEG format.
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Also, please remember that you should not embed the images into the body of the text document you submit. Images must be submitted separately from the textual submission.

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An abstract of your article is not required. However, if you choose to provide us with one, we will print it in a separate box.

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