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Editorial

By Dr David Muscat

Dear colleagues,

We hope that with so many people vaccinated now, the Covid-19 situation will improve and we will get back to normal but it seems that we will now be living in a 'new normal.'

The DAM has managed to organize two successful events this Summer and I have summarised them.

We have two more lectures lined up. One on *Management Of Trauma In Anterior Teeth* and one on *The Use Of Hyperbaric Oxygen In Treatment Of Osteonecrosis Of The Jaw*.

The refurbishment of the Dam office in the Federation Building of Professional Associations in Gzira is going well, thanks to the efforts of Drs Noel Manche and Nicholas Busuttill Dougall.

We hope you have had a great Summer break. The front cover is a painting by the talented Dr Rebecca Schembri Higgins.

Best regards,

David

Dr David Muscat B.D.S. (LON)
Editor / Secretary, P.R.O. D.A.M.

The Holy Spirit Hospital of Nuremberg

This hospital was the largest hospital in the former free Imperial city of Nuremberg. It was used as a hospital and a nursing home. Its chapel was also the depository of the Imperial Regalia, the crown jewels of the Holy Roman empire between 1424 and 1796. For coronations they were brought to Frankfurt Cathedral. The hospital was established as a private endowment by the wealthy Konrad Gross in 1332-1339, and served the elderly and needy. After 1500 it was extended over the river Pegnitz according to plan by Hans Beheim the elder. The north wall of the former



hospital church survives today with its polygonal ridge turret.

Nowadays the property is used as a restaurant and home for the elderly. 🏠

The Hospital Museum of Nuremberg, Germany



This museum is located in the well preserved hospital pharmacy rooms with beautiful oak furnishings and receptacles with powders and herbs. It shows the progress in the Health system from the middle Ages to present day.

The museum documents the history of the municipal hospital and of the Medical and Health services in Nuremberg. There is a collection of medical instruments and a distillation plant (circa 1870.) 🏠

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Cracks and fractures affecting the pulp in teeth



By Dr Ritienne Galdes

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A cracked tooth is defined as a fracture that extends from the coronal surface of the tooth vertically towards the root passing through its different structures (1). The term "cracked tooth syndrome" was described by Cameron as 'an incomplete fracture of a vital posterior tooth that involves the dentine and occasionally extends to the pulp' (2).

With regards to symptoms, this term referred to teeth with sharp pain on biting, pain upon releasing the pressure of a bite and unexplained thermal sensitivity. Clinically these teeth have deep periodontal pockets in the area of the crack which is high in comparison to the other pockets circumferentially (3).

Epidemiological analysis showed that fractures are the third most prevailing cause of tooth loss in developed countries, showing that this syndrome is of high clinical importance (4).

Five types of cracks have been outlined by the American Association of Endodontists (AAE) namely craze lines, fractured cusp, cracked tooth, split tooth, and vertical root fracture (VRF) (5).

CAUSES

Epidemiological data shows that the cracked tooth syndrome (CTS) affects all ages but in particular those in the range of thirty to sixty years of age (3). In his research, Kang et al. found that cracks were more common in people aged over fifty years and increasing incidence over sixty years, in 2016 (1). In fact, research shows

Author	Year	Incidence Data
A. Hiatt (8) Cameron (2)	1973 1976	1. Lower Second Molars (highest incidence) 2. Lower First Molars 3. Upper Premolars 4. Upper Molars (lowest incidence)
B. Weine et al. (9)	1982	Agrees with A. in 1 st and 2 nd but 3 rd and 4 th were inverted
C. Ehrmann and Tyas (10)	1990	Agrees with A. in 1 st , 2 nd and 3 rd
D. Krell et al. (11)	2007	1. Lower Second Molars (30%) 2. Lower First Molars (29%) 3. Upper First Molars (21%) 4. Upper Second Molars (8.9%) 5. Upper Premolars together (8.9%)

Table 1

that dentine loses elasticity and fatigue resistance with age (6,7).

Table 1 (above) shows the incidence of cracks of different teeth that spans over four decades.

Evidence supports this and explains the high incidence of fractures of the mandibular molars as a result of their vicinity to the temporomandibular joint (TMJ) (2,12).

The aetiology of fractures of teeth is multi-factorial, important causes include:

1. Trauma due physiologic forces when excessive force is applied to a weakened tooth (4).
2. Physical injury including occlusal factors such as biting on hard food. Trushkowsky described that the most common aetiology of a



fracture is that of 'a masticatory accident' which occurs with sudden biting on hard food such as a cherry seed with extreme force (13). This usually results in a vertical fracture. Periodontally involved teeth are usually less prone to masticatory accidents since these teeth move with the force and dissipate the blow (14).



3. Restorative procedures such as application of dentinal pins or the non-incremental placement of a resin restoration (15). Over preparation of cavities such as in a mesio-occlusal-distal restoration of a premolar results in weakening of the buccal and palatal or lingual walls which increases the risk of fracture (14).

Another possible cause of a fracture is through the differences in the co-efficients of thermal expansion of the tooth tissue and the restorative material being placed during an operative procedure (16).

4. Wear and tear such as in the ageing dentition result in teeth having a higher predisposition to cracks. The elasticity of teeth decreases with age while their brittleness increases. If the occlusal forces exceed the elastic limit of the dentine, fractures result (17).



5. Bruxism is a term that joins parafunctional grinding habits that result in wearing down of the occlusal surfaces. These result in the creation of substantial amounts of occlusal forces especially nocturnal bruxism, which can lead to tooth fractures (18). Lynch et al. describes these parafunctional habits as damaging horizontal forces (12).
6. A weak tooth structure due to morphological factors. Tooth shape factors that are associated with a higher chance of fractures include deep grooves, large pulp spaces, steep cusps and cusp angles (19).

The anatomy of upper premolars make them more prone to fractures due to the deep cusp – fossa relationship with lower premolars (1).

The palatal cusps of upper molars can be defined as plunger cusps. In occlusion, these cusps tend to wedge into interproximal areas or between the cusps of lower molars with significant force, causing an impaction.

This leads to fatigue in the structure of their lower antagonists. The central fossa of lower molars is deeper than that of upper molars which makes the lower molars at a higher risk of fracture.

Furthermore, upper molars have an oblique or transverse

ridge which results in structural reinforcement and thus, these teeth resist more crack formation (10). Anatomical features can vary even due to the race or ethnicity of the patient. In fact, Roh and Lee showed that in Korean people, upper and lower molars had similar chances of sustaining cracks.

The reason behind this difference is that their lower molars are tilted lingually and thus, their buccal cusps act as a plungers of the upper molars, which results in a higher frequency of cracks in the maxillary molars (20).

TREATMENT

Worldwide, there is no particular restorative protocol that one can follow to best treat a cracked tooth (21).

The American Association of Endodontists (5) defined five types of longitudinal tooth fractures. Making such a diagnosis can be used to decide the treatment required.

- Craze lines are very shallow, tend to cause no pain and thus, do not require any treatment beyond mild restorative treatment for aesthetic concerns.
- Fractured cusps can cause mild to moderate pain depending on depth. These are usually treated with restorative procedures as described below.

Continues on page 7.

SENSITIVITY & GUM PROBLEMS CAN CO-EXIST^{1,2}



Gum recession is a leading cause of dentine exposure³, which can cause dentine hypersensitivity. Research shows that 44% of patients with dentine hypersensitivity changed their tooth brushing technique to avoid the affected areas,⁴ which may result in poor plaque control, a reason for continued dentine tubule exposure.³ In fact 50% of people prone to sensitivity also report concerns about their gum health.⁵

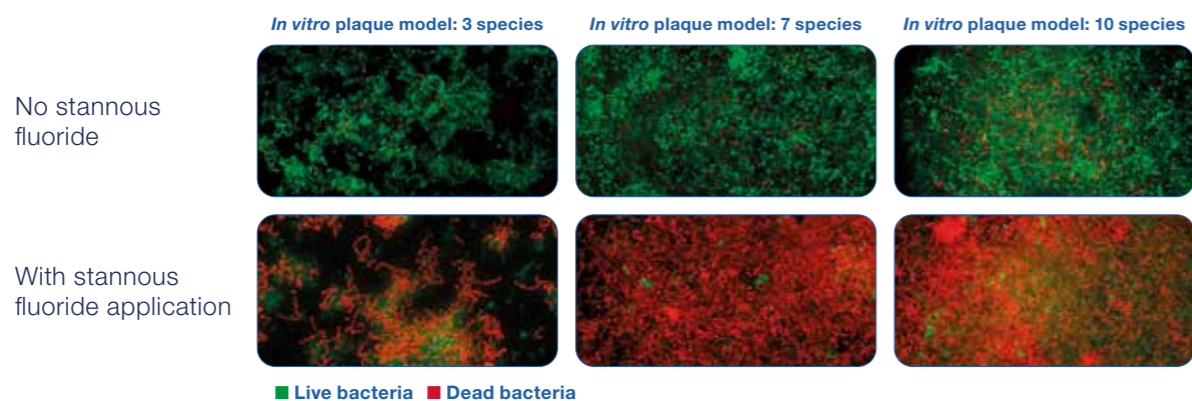
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SENSODYNE SENSITIVITY & GUM PROMOTES GUM HEALTH THROUGH EFFECTIVE PLAQUE CONTROL⁶



Significant loss of viability of in vitro plaque when treated with 0.454% stannous fluoride toothpaste. Confocal Laser Scanning Microscopy (CLSM) images of in vitro plaque models with 3 (left), 7 (centre) or 10 (right) dental plaque bacterial species. The protocol and bacteria species used followed a model previously described in Malcolm et al. (2016) and Stephen et al. (2016). Samples treated with slurry of 16% w/v toothpaste for 3 minutes. Control represents untreated in vitro plaque models of 3, 7 or 10 bacterial species, respectively.

Aerobic and anaerobic bacteria, found in early and mature plaque, are affected by the antimicrobial action of stannous fluoride.^{6,9}

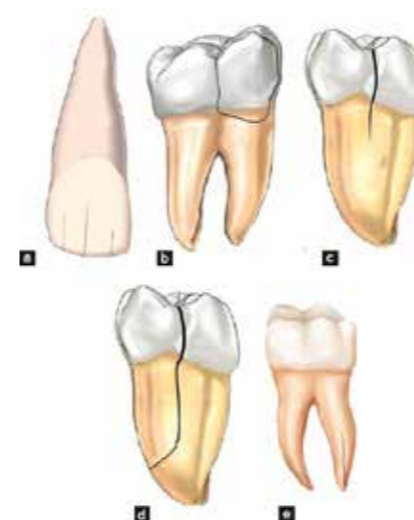
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Cracks and fractures affecting the pulp in teeth



Continues from page 5.

- A cracked tooth indicates that the crack extends from the occlusal plane, vertically towards the root. Early diagnosis is important to salvage the tooth. If the crack extends into the pulp and the tooth is still restorable, it requires pulpal therapy. On the other hand, if the crack extends below the gingival margin, the tooth is usually not treatable and it must be extracted.
- A split tooth usually results from propagation of a crack over a period of time. In this case, the tooth cannot be saved intact. Depending on the position of the split, it might be possible to save part of the tooth through a root canal procedure and hemisection of the non-fractured part of the tooth.
- Vertical root fractures are cracks that originate in the root and extend towards the coronal portion. These usually are not diagnosed until an infection occurs in the surrounding areas. Thus, these teeth are usually extracted, with the exception of cases where endodontic surgery

can be performed to remove the fractured apical part.

The image on the left shows the different types of fractures (22).

IMMEDIATE TREATMENT

The aim of immediate treatment is to prevent propagation of the crack. This could be done through three methods. The first is by carrying out occlusal adjustments, however this requires the sacrifice of a lot of tooth tissue and requires further treatment in the future.

In the second method, the fractured segment is removed. This is advisable to be carried out only in cases where the fractured part is small cause in other cases it is considered to be too damaging (10). Conversely, Fox et al. believes that removing the fractured part will allow full assessment of the extent of the fracture (23).

In the last method, immobilisation of the segment is performed. This is best carried out through a direct composite splint. This restorative material is readily available in practice, its cheap and a quick fix.

The direct composite splint is carried out by slight reduction of the areas that are in occlusion and direct bonding of composite over the surface of the tooth.

Other methods which are less advisable due to high destruction or require a lot of time for manufacture include placement of a copper ring, an orthodontic band or a temporary crown (21).

RESTORATIONS WITH/WITHOUT CUSPAL COVERAGE

In cases where the pulp is in a normal, hypersensitive or reversible

pulpitis state, restorations can be placed. In the decision process for these procedures, the first decision is the kind of material to be used.

The most common materials used are composite, amalgam or glass ionomer cements (GIC). Extensive literature confirms that amalgam is very successful when used for direct plastic restorations.

Bonded amalgam restorations have achieved a lot of success in reducing post-operative sensitivity, which might be related to the dentinal tubules being sealed by the adhesive liner (24,25).

In the case of the resin, some have hypothesised that when used as a direct restoration without cuspal coverage, the adhesive layer is lost due to repeated stress over the restoration.

This leads to inefficient stabilisation of the fractured portion (26). The most cited advantage of composite is its tooth-like appearance while the main cause of failure is due to the polymerisation shrinkage whilst setting (27).

GICs are usually not recommended for immobilisation of segments since its bond strength to enamel and dentine is lower than the other restorative materials previously mentioned (28).

Being at a higher risk of complications involving the pulp, preparing cracked teeth to receive indirect restorations will further threaten the pulps' vitality and more tooth tissue will be lost (29).

Continues on page 8.

Cracks and fractures affecting the pulp in teeth

Continues from page 7.

PULPAL THERAPY

Opdam et al. explained that pulpal involvement or complications are more common in teeth with cracks especially those that were symptomatic to hot temperatures (29).

If the pulp is symptomatic, in a state of irreversible pulpitis or the crack extends to the pulpal system, a type of pulpal treatment is required (30). These treatment modalities are described below, starting from mild exposures to more severe cases:

- Direct pulp capping could be used depending on the extent of trauma or age of the patient.
- Pulpectomy could be the treatment of choice in mild to moderate exposures of vital pulps rather than immediate root canal treatment (31).

- Root canal treatment in cases of severe symptoms or deep fracture into a vital pulpitic pulp.

- Root treatment in a cracked tooth with pulpal necrosis or one that has been previously root treated.

Through an endodontic access cavity, the clinician can visualise the whole pulpal floor and the extent of the crack. In cases where the crack spans the floor in a buccolingual direction in a mandibular molar or the crack involves one of the roots in a maxillary molar, root resection can be the choice of treatment (32).

Opdam et al. described a case in which a molar that had sustained a vertical fracture was root treated and hemisection of the mesial root was performed (29).

If the crack runs through the whole width of the floor, extraction should be deliberated. Extraction is carried out in cases that cannot

be treated with any of the above mentioned treatments such as in split tooth cases or those that suffered vertical root fractures.

PROGNOSIS

The prognosis of cracked teeth presents a challenge to dental surgeons, since even with treatment their longevity is unpredictable. The prognosis of cracked teeth usually depends on the extent and location of the fracture, the location, depth, size and number of cracks affecting the tooth (10). The time when restorative treatment is provided and the type of restoration used to splint the crack also affects prognosis (21).

Factors that worsen the prognosis of cracked teeth include (1,3):

1. Multiple directions of the crack.
2. Fractures involving the pulpal space.
3. Cracks extending to subgingival areas, involving the sub-pulpal floor.
4. Tooth being the terminal one in the arch.
5. Pulp necrosis at the initial examination.
6. Deep probing depths.
7. Fractures involving both marginal ridges.
8. Preoperative pain.
9. Mandibular dental arch.
10. Tooth type particularly molars.

Early diagnosis could be the key for long term survival of cracked teeth (6). The practitioner has a challenging question to answer every time a patient asks for the prognosis of treatment on their cracked tooth (33).

Most cracked teeth continue to act as functional units after receiving treatment. As shown from the literature, there is a lot of variation in outcome and opinions for treatment. The symptoms must be



kept in mind for early diagnosis to be made and treatment should be based on indications according to the severity of the crack. ■

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OCCLUSION IN THE DENTAL PRACTICE: PART 2



By Dr Daphne Rizzo

Dr Daphne Rizzo qualified at the University of Malta BChD (Malta) in 2015 after five years of undergraduate study. She has recently completed her 3-year MSc in Aesthetic Dentistry via distance learning at Kings College London. Dr Rizzo works in private practice and is also a part-time clinical demonstrator at the University of Malta Teaching Clinic.

In the previous article we had already established that by following a standard parameter of care with our occlusal assessments and examinations for all our patients, clinicians will gain a distinguished sense of predictability over their clinical outcome with respect to restoration longevity, improved aesthetics (as form follows function), increased productivity by reducing chair-side time and stress associated with occlusal adjustments and most importantly increasing patient comfort and overall quality of life of the individual.

In this article we will focus more on the clinical component of occlusion by going through some steps which one may undertake to achieve a predictable, functional and aesthetic outcome.

PHYSIOLOGIC OCCLUSION VS PATHOLOGIC OCCLUSION

To start with we must first define what is a physiologic occlusion. This is an occlusion which lies in harmony with the masticatory system; including our neuromuscular activity and that is well tolerated by the teeth, periodontium and the temporomandibular joints (TMJs).¹

It is an occlusion which enables the patient to function efficiently and comfortably.

On the contrary any occlusion that disrupts the masticatory system; that may become symptomatic and cause pathology and/or trauma such as (pathologic) tooth

wear, temporomandibular joint disorders (TMJD), broken cusps and restorations may be termed as a pathologic occlusion (if and when all other diagnostic criteria are evaluated and no other cause and effect relationship is found and other pathologies are excluded).¹

One important point to bear in mind and which, unfortunately, is also a cause for overtreatment in dentistry,² is that having a malocclusion does not instinctively imply that one has a pathologic occlusion.³

As an example, a patient having a Class II division 1 incisor relationship does not achieve immediate disclusion of posterior teeth on all eccentric movements.⁴

Nevertheless, this type of occlusion normally termed as a “malocclusion” can still be physiological due to the adaptive capacities of the masticatory system and the stable tooth-tooth relationships.⁵

Changes in these tooth-tooth relationships and occlusal forms such as cuspal slope changes in our restorations may however surpass this adaptability with resultant consequences.

Beyron’s proposed principles of occlusion,⁶ mentioned in the previous article, form the basis of any physiological occlusion and can help us clinicians to achieve a predictable functional and aesthetic treatment outcome especially when undertaking rehabilitative cases.

CONFORMING OR RE-ORGANISING OCCLUSION

Prior to embarking on any treatment be it a simple occlusal restoration, fixed or removable prosthetics, we must analyse our patient’s occlusion and decide upon an occlusal scheme.

Sometimes a simple clinical occlusal examination will suffice; however in most cases proper evaluation can only be attained extra-orally by means of articulated study models.

If the patient is currently having a stable, asymptomatic and comfortable occlusion then we must do our utmost to ‘copy’ that occlusion in our future restorations, what is known as using a conformative approach.

Failure in doing so may create unstable tooth contacts which may progressively lead to occlusal interferences and a sequelae of occlusal dysfunction events.

When the present occlusion is symptomatic however, such as when a patient presents with unstable tooth-tooth relationships, pathological tooth wear, fractures of restorations or teeth and where complex restorative and/or prosthodontic treatment will be required anyway, then a reorganised approach must be considered in order to provide the patient with a stable and reproducible occlusion and achieve stability in both teeth and final restorations, given that an informed consent has been obtained.^{7,8}



Figure 1: Demonstrating canine-guidance on a left lateral excursion (top), same patient demonstrating group function on a right lateral excursion (bottom)

Mutually Protected Occlusion

Our endpoint when undertaking restorative rehabilitation involving a reorganised approach should (ideally) be to achieve a mutually protected occlusion.

The concept of a mutually protected occlusion is regarded as the ideal occlusal scheme for a natural dentition.

This concept combines two of the most important occlusal principles; it requires a dentition to have even contacts in maximum intercuspation (MIP) with the posterior teeth withstanding the most occlusal (axially directed) forces and minimal contact on the anterior teeth. In protrusive and lateral excursive movements however, the anterior teeth should protect the posterior teeth by withstanding loads on these movements primarily by disclusion of the latter.

Lateral guidance may be provided by the canine teeth (canine guidance) or by the posterior teeth (group function) as seen in Figure 1 below. Some theories about the physiological anatomy of the teeth, their supporting structures and their adaptation to withstanding various loads have been made however clear scientific evidence supporting these theories is lacking.^{9,10,11,12}

A case in point is that a true canine-guided or group function is seldom ever found in the natural dentition as stated in a systematic review compiled by Abduo et al.⁹ in 2013.

Nevertheless, a canine-guided occlusion should be primarily considered when a reorganised approach is being undertaken unless circumstances doesn’t allow. In the case of a compromised cuspid or absent canine, for example, shared posterior occlusal contacts on the working side (group function) should be considered instead.¹³

Apart from being easy to fabricate and to modify, it facilitates posterior tooth disclusion and decreases the likelihood of unwanted tooth contacts.

Different Occlusal Schemes

Although the basic principles remain the same, as to the provision of a harmonious occlusion, different occlusal schemes (such as a bilaterally balanced occlusion or a unilaterally balanced occlusion, monoplane or lingualised occlusion) might be considered depending on the treatment being proposed.

The end-result should leave a dentition with a stable and functional occlusion.¹⁴ When undertaking treatment involving removable prosthesis, especially complete dentures, the concept of a bilaterally balanced occlusion, as an ideal to enhance denture stability and retention in complete denture treatment was proposed, mainly, from clinical observations.⁷

However, in a systematic review by Farias-Neto et al.¹⁴ in 2013 it was concluded that this scheme is

not a must for complete denture wearers as it has no effect upon masticatory function and patient satisfaction in the long-term.

Other studies have found that there was no one occlusal scheme that offered better masticatory function in terms of patient-reported outcomes.¹⁵

A study carried out by Grech et al.¹⁶ in 2020 however found that new complete denture wearers having a lingualised occlusion required the least adjustments when compared to those having a balanced or a monoplane occlusion hence a lingualised occlusion may be the occlusal scheme of choice when considering complete denture treatment.

CASE PRESENTATION

In the following case I will explain the clinical components and methods that one may use when carrying out a rehabilitative case using a reorganised approach.

This case includes the management of a 49-year-old male patient presenting with mild localised anterior tooth wear and posterior edentulous spaces as shown in Figure 2. A full periodontal examination, a detailed smile evaluation and edentulous space assessment, apart from the standard full mouth examinations, was carried out for this case; the details of which will not be included below.

Continues on page 12.

OCCLUSION IN THE DENTAL PRACTICE: PART 2

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A combination of direct and indirect restorative techniques were included in this treatment plan. It is beyond the scope of this article to delve into the details of all the clinical procedures which were carried out. Treatment related to the occlusal aspect, however, will be explained in the sections that follow.

Brief Case Overview

The patient presented at the dental clinic concerned about his 'chipped front teeth'. He also noticed that his lisp had worsened by time. Although the patient did not have high aesthetic demands, he became aware of his current dental situation and wanted to do something about it. Patient is generally fit, although his past medical history was contributory to his current oral condition.

Patient's History of Presenting Complaint

Patient used to be a nail biter and had a history of opening beer bottles with his teeth. He frequently used a pocketknife to clean his teeth interdentally. He claimed to have stopped these habits some years ago. Patient is not a bruxist.

The missing teeth in the lower arch, which include teeth 36, 37



Figure 2: Pre-operative full arch occlusal: upper (left) pre-operative full arch occlusal: lower (right)



Figure 3: Pre-op close-up anterior view of the incisors



Figure 4: Pre-op close-up occlusal view of the maxillary anterior teeth



Figure 5: Anterior smile (close-up)

and 46, were extracted about 7 to 8 years ago due to caries. Patient did not seek any treatment for the missing teeth until now.

Occlusal Assessment

Apart from our usual assessments, a detailed occlusal assessment is paramount before undertaking any restorative or prosthodontic work.¹⁷

During this phase of treatment we should consider both static and

dynamic relationships. For the latter, one must also determine the retruded contact position, also known as RCP. This is the first point of contact in the most retruded unforced jaw position (RP) or when in centric relation (CR).¹⁸ This is an important maxillomandibular relation contact to determine due



Figure 6: Right lateral in occlusion (left), anterior in occlusion (middle), left lateral in occlusion (right)



Figure 7: Right lateral in excursion (left), protrusion (middle), left lateral in excursion (right)



Figure 8: Checking for RCP using a Hoffmann leaf gauge



Figure 9: Confirming RCP using bimanual manipulation

to the ever-changing and dynamic process which surrounds occlusion. It is easily reproducible hence it is used as a point of reference when mounting casts on an articulator.

It also plays a significant role when using centric relation occlusion to acquire the desired space for our restorations without changing the vertical dimension of occlusion (VDO).¹⁹ It is thus important to replicate this contact in our treatments should this require restorative care as is what happened in this case.

There are several ways how one can determine the RCP. One simple way is to use a leaf gauge (such as the Huffman numbered leaf gauge) as shown in Figure 8 below. Another method is to use bimanual manipulation.

Clinician experience and training for the latter is definitely an added advantage. In this case I used the Huffman gauge and confirmed this contact through bimanual manipulation as shown in Figure 9.

The following are the findings of the occlusal assessment that was carried out for this patient.

- No mandibular deviation on opening and closing
- Interincisal distance: within normal limits (WNL) 45 mm
- Maximum degree of lateral movement: 11 mm R and 10mm L

Static:

- Incisor relationship: Class III, edge-to-edge incisor relationship
- Overjet: no overjet
- Overbite: no overbite
- Canine relationship: Class I R and L
- Molar relationship: R Tooth 46 missing L no molars present
- Upper and lower centrelines do not coincide with a 2mm shift to the left
- Mild crowding present in the lower labial segment
- Residual spacing of 8.5mm (measured from the height of contours of teeth 45 and 47) following the loss of tooth 46
- No crossbites present
- Teeth 16 and 26 are slightly rotated mesially, tooth 14 is slightly rotated distally, tooth 27 is tipped buccally, teeth 32 and 41 are slightly rotated mesiolingually and tooth 47 has drifted and tipped mesially
- Supra-eruption of tooth 27 is noted
- Freeway space: 2mm

Dynamic:

- Right lateral excursion first 1-2mm: group function >2mm: canine-guidance
- Left lateral excursion first 1-2mm: group function >2mm: canine-guidance
- Not all posterior teeth disclude on protrusion, contact lies between teeth 13 and 44, 15 and 45, 11 and 42, 22 and 33
- Anterior guidance: shallow close to no guidance due to

- the presence of an edge-to-edge incisor relationship
- No working side and non-working side contacts on lateral excursions
- Retruded contact position (RCP), first tooth contact on a retruded arc of closure, is on tooth 25

Treatment Plan

Following is a simple overview of the treatment plan carried out.

- Preventive
 - Oral hygiene instructions (OHI)
 - Dietary advice
 - Fluoride application
- Stabilisation

Periodontal therapy as follows:

- Full mouth supragingival calculus debridement and non-surgical root surface debridement (RSD) under local anaesthetic for localised areas with pockets \geq 4mm
- Review and re-assess periodontal situation after 3 months by carrying out 6-point pocket chart, repeat RSD if necessary
- Supportive periodontal therapy

Direct resin composite restorations for carious lesions present on teeth 11, 12, 13, 14 and 47

Extraction of teeth with hopeless prognosis: tooth 28, tooth 48 and tooth 24

- Aesthetic
 - Vital bleaching, home-kit to improve teeth colour on patient's request
- Tooth wear management (treating functional and aesthetic concerns)

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OCCLUSION IN THE DENTAL PRACTICE: PART 2

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- Short-medium term restorations: direct labial and palatal resin composite veneers for teeth 12, 11, 21 and 22 and direct resin composite palatal veneers on teeth 13 and 23 to restore tooth surface loss.
- Provision of a thermoplastic splint for long-term wear (night-time) to protect restorations
- Prosthetic
 - Surgical placement of implants (36 and 46) using the interim denture for the construction of a surgical guide and a delayed loading protocol
 - Replacement of tooth 24 using a cantilever design resin-bonded bridge ("Maryland" bridge) utilising a wrap-around design on the abutment tooth 25
 - Restoration of teeth 36 and 46
- Recall and reassessment
 - Monitor oral hygiene (continuously)
 - Re-evaluate periodontal situation (repeat 6-ppc after 3 months) prior to restorative intervention of tooth wear
 - Repeat radiographic images as required
 - Monitor all resin composite restorations, long-term maintenance by polishing or repairs if necessary
 - Monitor implant-supported restorations
 - Long-term definitive restorations: contingency planning as discussed for resin composite veneers and resin-bonded bridge; monitor compliance of splint (long-term wear)
- Monitoring and maintenance
 - 4-6-monthly check-up appointments, reinforcing OH and scaling (or RSD) as necessary, refurbishment of resin composite restorations as required, monitoring of implant-supported prosthesis, re-evaluation of occlusion and splint review with adjustments done as necessary

Continues on page 15.

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OCCLUSION IN THE DENTAL PRACTICE: PART 2

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Study Models

Treatment planning must be carried out, where necessary, using mounted casts on adjustable articulators, as seen in Figure 12. Facebow (Figure 10) and occlusal records will allow us clinicians to simulate and better assess the occlusion visible in the patient's mouth.

A facebow is primarily used to mount the maxillary cast on an adjustable articulator. It can also be used to transfer information about the intercondylar width distance to the articulator. This helps the clinician/dental technician to programme and set the articulator controls.¹⁹

A facebow uses two to three points of references, which may vary between different articulators, but are usually the terminal hinge axis and the nasion/inner canthus of the eye, to reproduce (as much as possible) the correct position of the maxilla.

This will demonstrate the extent (if present) of any canting which will undoubtedly have an impact on our prosthodontic or restorative efforts.



Figure 10: A view of the equipment, materials and instruments used for the facebow registration and inter-occlusal records



Figure 11: Facebow recording

Once the models have been mounted and the articulator programmed, a custom-made incisal guidance table can be made to replicate the existing anterior guidance into the definitive restorations. The use of an incisal guidance table is deemed helpful especially when restoring multiple anterior teeth.

Due to the minimal additions needed and the choice of restorative material (resin composite) for restoring the anterior teeth, an incisal guidance table was not required for this case.

Continues on page 18.



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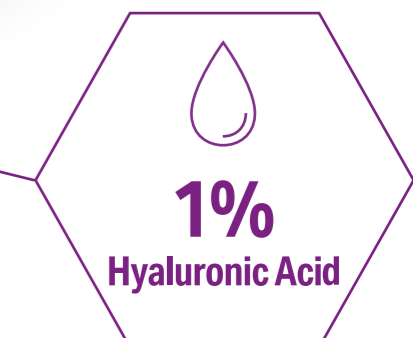
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OCCLUSION IN THE DENTAL PRACTICE: PART 2

Continues from page 16.

In this case study models were articulated using a facebow record, a centric relation record and a protrusive intra-occlusal record. The latter was used to set the condylar guidance angles on the articulator.

Tooth Wear Management

Acquiring Space for Restorations

The patient presented with an unfavourable Class III edge-to-edge incisor relationship which might have been aggravated by and led to the tooth surface loss due to the lack of anterior guidance together with his past dietary habits and intrinsic condition.

The patient was not interested in undergoing orthodontic treatment, moreover he wanted to keep the treatment as minimally invasive as possible. For this reason as well as taking into consideration the amount and location of wear (less functional requirements), the amount of tooth structure and adequate amount of enamel available for bonding, direct composite veneers were deemed to be the best option for the patient to get a nice aesthetic and functional result. The use of composite for restoring mild to moderate cases of localised anterior tooth wear has been highly advocated in the literature.^{20,21,22}

Nevertheless, due to the lack of interocclusal space available in ICP it was deemed the best option, to minimise alterations in the vertical dimension of occlusion and to gain the minimal space required for these restorations, to use a combined approach of CR (utilising the discrepancy present between ICP and RCP) and the Dahl principle.²² The space acquired can be seen in Figure 12. In this way, posterior teeth contacts will be achieved by relative

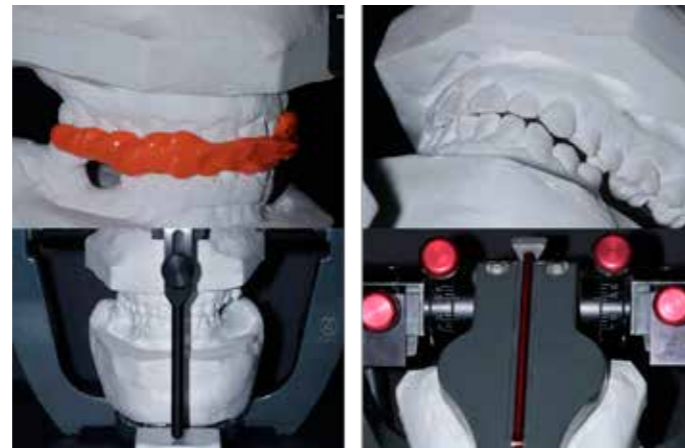


Figure 12 : Mounted models in centric relation on a semi-adjustable articulator with the incisal pin at 0mm and programmed condylar guidance angle



Figure 13 : Mounted models showing the denture trial for the construction of an interim flexible removable partial denture



Figure 14 : A series of photographs showing the designated lines and design guides, using calibrated rulers, to form a two-dimensional digital diagnostic wax-up which will be used by the dental technician to form the three-dimensional diagnostic wax-up



Figure 15 : Mounted models showing the diagnostic wax-up

axial tooth movement. However, when taking into consideration the edentulous spaces present, it was advisable to provide the patient with an interim partial denture to have control over tooth movement avoiding

unwanted changes in the occlusal plane and further supra-eruption of the non-opposing posterior teeth.

Continues on page 20.

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OCCLUSION IN THE DENTAL PRACTICE: PART 2

Continues from page 18.

The use of the Dahl concept in gross Class III malocclusions has been contra-indicated due to the limitations of tooth movement²³ however, the patient did not fit these criteria.

Diagnostic Wax-up

In this case, a diagnostic wax-up was deemed necessary in order to gain full control over the occlusal endpoint as well as to facilitate control over the aesthetic prescription as indicated by the digital smile design prepared.

Silicone keys can then be prepared over the wax-up. The first silicone key as seen in Figure 16 (top) was filled with a self-curing

composite material and used for the patient to test out the aesthetics, phonetics as well as function prior to restorative intervention.

The second key, as seen in Figure 16 (bottom) was used to allow me to have full control of composite placement over the palatal and incisal forms of the teeth to be restored. Although the direct placement of composite in the palatal aspect presents some challenges, the use of a modified palatal silicone index using clear silicone will facilitate the placement of composite in this area. Using a wax-up will guarantee (to a certain extent) a predictable outcome on the occlusal, phonetic as well as the aesthetic components and is highly recommended especially when restoring multiple teeth.^{24,25,26}

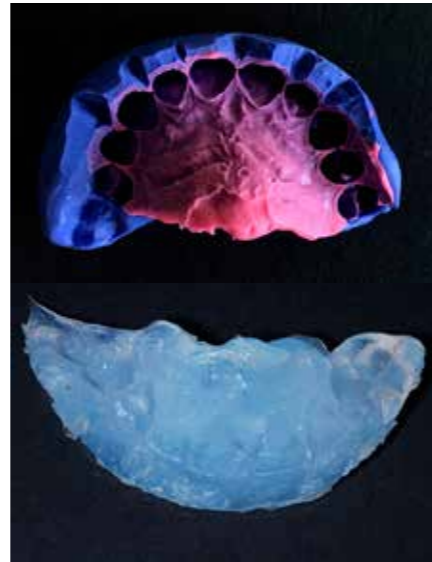


Figure 16 : Silicone indices made directly from the wax-up

POST-OPERATIVE PHOTOGRAPHS



Figure 16 (Left): Post-operative full arch occlusal: upper (top), pre-operative full arch occlusal: lower (bottom) at one year recall



Figure 17 (Below): Post-op close-up anterior view of the incisors at one year recall



Figure 18: Post-op close-up occlusal view of the maxillary anterior teeth at one year recall



Figure 19: Post-op anterior smile (close-up) at one year recall



Figure 20 : Post-op right lateral in excursion (left), protrusion (middle), left lateral in excursion (right) at one year recall

OCCLUSION AND THE DIGITAL WORLD

With advancements in technology, dentistry has taken a revolutionary turn. Digital dentistry is improving patient experience while magnifying the clinician's work efficiency and accuracy as well as opening new horizons for both researchers and students.²⁷

The subject of occlusion has not been exempted from this digital slipstream. Virtual facebow transfer and virtual articulator mounting has become possible.

The use of virtual articulators in our daily practices may predominantly simplify our assessments and treatment planning protocol and greatly reduce the errors that may be brought about with the use of traditional articulators, which rely heavily on the technician's and/or clinician's experience.²⁸

The level of accuracy in determining dynamic occlusal relationships has been however challenged in the literature and further tuning and probing to current and possible future digital software is indispensable.^{29,30}

Concomitantly the use of virtual facebows embodies the future of dentistry. Through the use of photographs, 3D face scans, cephalometric images and CBCT, one may mount their scanned models using a virtual facebow.³¹ However the use of radiographs principally to orientate the arches in a three-dimensional way using a virtual articulator raises a cause of concern.³²

Even though the study of digitalising dentistry has been present since the 1970s with the evolution of CAD/CAM, the need for further research is palpable in order to smoothen this transition into the digital world.²⁷

COMMUNICATION WITH THE LAB

Irrespective of whether we are using conventional or digital methods in our treatments, good communication between the dentist and their respective technicians as well as the patient, remains the fundamental cornerstone that optimises patient care.

A detailed and clear laboratory prescription form should be communicated and should include all the specific details required to render a good restoration.

The choice of occlusal scheme plays a big role in the details. Azzopardi et al.³³ found that the majority (20, n=38) of the dental technicians working in Malta reported that they receive no indication of an occlusal scheme for both removable and/or fixed prosthodontic work.

A dentist should also have a good understanding of the workflow and laboratory setup as well as the equipment being used by the dental technicians such as milling machines, the types of ceramics and of course the types and models of their articulators.

Dental articulators offer a way of communication between the clinician and the dental laboratory.

This does not implicate that a clinician should own one, however it is good practice to invest in a facebow apparatus that corresponds to one of your dental technician's adjustable articulators.

Apart from ensuring a smooth workflow between the dental chair and the laboratory, it increases the work predictability, reduces the chair-side time spent adjusting occlusion and the fear and frustration that come along with it.

CONCLUSION

The patient's mouth remains to date, the best articulator however many of our treatments that have the potential to alter one's occlusion, present a challenge to deliver using just visual tools. Auxiliary tools such as facebows and articulators will facilitate the study of our patient's occlusion.

The clinician's as well as dental technician's knowledge and the correct use of such instruments ensures an unparalleled standard of care and peace of mind for any eventualities.

The absence of an 'ideal occlusion' does not necessitate treatment. Remember, that deviation is the norm rather than the exception. We must consider occlusion as a dynamic process which is subject to change and adaptation and varies from patient to patient.

Environmental or biological factors may constitute changes in the occlusion, such as where a person is exhibiting bruxism due to a stressful situation in life, hence regular check-ups with occlusal analysis should be a standard protocol in our treatment plans for the long-term maintenance of restorations and oral health of all our patients. ■

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THE LATEST NEWS IN DENTISTRY

RADIATION PROTECTION

The Commission for the Protection from Ionising and non Ionising Radiation has been in contact with the Dental Association of Malta to convey the following message to our members 'reminding them of the legal requirement for constancy testing of all X ray equipment every two years. Failure to do these will result in withdrawal of authorisation for use and any other legal action.'

ANTIBIOTIC RESISTANCE

Antibiotics are the cornerstone of modern medicine and crucial to protect from fatal disease. They are used to reduce risk for certain procedures and to protect vulnerable patients such as those having chemotherapy.

Certain orodental infections can be life threatening . Overuse and misuse of antibiotics are causing drug resistant infections. Antibiotic Resistance is a threat to wealth and health..When you need antibiotics you need them to work.

The Antimicrobial Resistance working group of the FDI along with experts from five different regions of the World have recently drafted a pledge to encourage action on antibiotic resistance in dentistry. This pledge includes activities that may be undertaken by dental Associations and other organisations in their fight against antimicrobial resistance.

These activities are based on recommendations in the FDI White Paper on the essential Role of 'Dental Teams in reducing Antibiotic Resistance 'and 'WHO Global Action Plan on antibiotic Resistance.'

Dentists are responsible for about 10% of Antibiotic prescribing for humans globally. Oral Health professionals have a clear responsibility to engage ,commit and contribute to global ,national and local efforts to tackle antibiotic resistance.

The FDI raises awareness and optimises antibiotic prescribing through antibiotic stewardship.

Ways to combat antibiotic resistance:

1. Promote evidence based guidelines in the prevention and control of infections in dentistry
2. Support education and interventions on oral hygiene and low sugar dietary advice
3. National action plans through dental antibiotic stewardship programmes including national and local approaches that involve audits of dental antibiotic resistance
4. Communicate to the general public about antibiotic resistance and appropriate use in dentistry
5. Identify learning opportunities for dental professional s and other health professionals on antibiotic resistance

MRONJ

eCancer is a UK based charity (founded by Prof Umberto Veronesi and Gordon Mcvie)which has offered to raise the standards of care for cancer patients across the World through free education. Two free online e-learning modules on Medication related Osteonecrosis of the Jaw for all healthcare professionals are offered.

These are entitled:

1. Fundamentals of MRONJ
2. Complete Guide on the management of MRONJ

The following will be covered:

1. How to describe measures to prevent MRONJ in cancer patients
2. How to describe the main risk factors for MRONJ development
3. When to suspect and how to arrive at an early diagnosis of MRONJ in each patient.
4. How to effectively collaborate with the dentist, oncology nurse and other healthcare professionals who manage cancer patients.

TECHMT

Tech.mt is responsible for a project called 'Women4IT' which is a multi stakeholder partnership funded by the EEA and Norway Grants Fund for youth employment. It offers improvement in digital skills.

Women aged 18-29 may register their interest . The Malta Council for the Voluntary Sector has passed on this information to the DAM.

THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE EESC

This is an institution established by the Treaty of Rome. Malta has been awarded 5 places in it. This institution ,together with the Committee of / regions (represented by the Malta Mayors Institution)must be asked by right to comment on all directives that the EU commission will be working on or issuing.

PROFESSIONAL ETHICS

In 2018 the MFPA carried out the project 'Professional Ethics' safeguarding the service to the consumer. This was done through funds provided by the Voluntary Organisations Project Scheme. Two quantitative studies with two essential cohorts were carried out namely the consumer and fresh graduates. M.Fsadni and Associates an independent market research firm carried out the studies.

The main findings were as follows:

- 3 in 5 of end user customers source a professional through word of mouth when requiring a service for the first time
- 1 in 4 end user customers rely on recommendations from other specialists in the field.
- Customers expect a good service, professional in act in a professional manner ,empathy towards customer and a good listener.
- 80 % of customers believe the term 'code of professional ethics' refers to a set of rules . Others believe that it refers to confidentiality and work being conducted in a professional manner.
- Only 1 in 2 customers believe that local professionals adhere to their code of professional ethics and some 40 % of customers consult more than one professional for the same problem /advice.
- 84 % of customers believe that professionals are legally obliged to follow a code of ethics when providing a service. 🇲🇹

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CAD CAM AND DIGITAL DENTISTRY LABORATORY

OF THE FACULTY OF DENTAL SURGERY AT THE UNIVERSITY OF MALTA

The Faculty of Dental Surgery has a new CAD-CAM laboratory, set up at the Biomedical Sciences building of the University of Malta.

This is a laboratory space dedicated to teaching and research on Digital Dentistry.

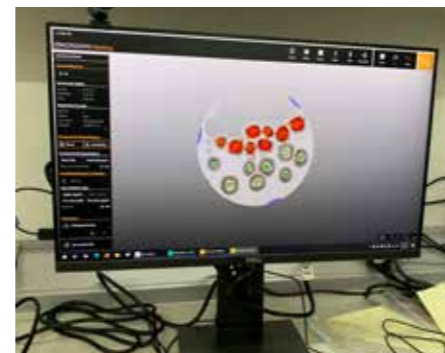
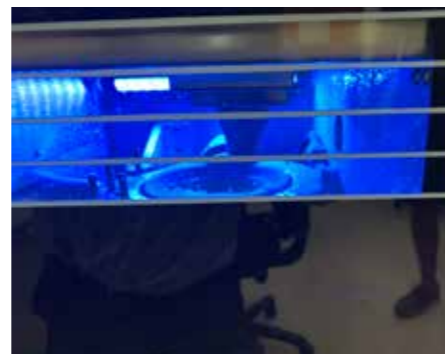
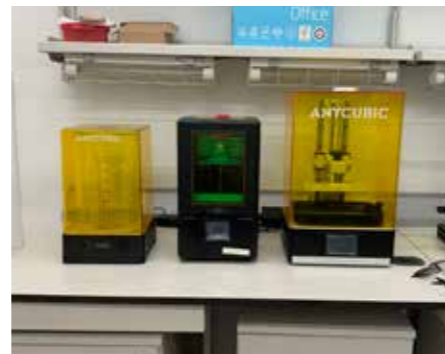
The laboratory has three new 3D printers, of which two are resin LCD 3D printers and the other is a filament 3D printer.

A 5 axis milling device (M1 Zirkonzahn) for PMMA resin, ceramics including Zirconia and metal has also been installed in the lab, along with a brand new furnace for sintering ceramics.

These devices were obtained by the University thanks to research grants and agreements spearheaded by Professor Arthur Cortes and the research team at the Faculty of Dental Surgery. The laboratory also has a laboratory sink, a fume hood and an office desk.

The laboratory is to be used for research and teaching purposes, such as for the new Master of Science in Digital Dentistry degree which has been approved and is due to start in October 2022.

Professor Cortes is currently supervising research by two Phd students namely Dr Juliana No Cortes and Dr Anne Maria Agius as both their theses are about Digital Dentistry. 📖



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Speakers:

Dr Samy Darwish BScBDS MFDRCS Dip.DSed MSC MClintDent MRDRCS LLM FDSRCS
Consultant oral surgeon consultant Periodontist Founder and Director Oral Surgery Ltd. Director Dakatra Ltd.

Dr Tarik Shembesh BDS (Hons) PgCAP MOM MSc MJDF RCS (Eng) MDTFEd FHEA
Clinical lead London MOS services Oral Surgery Ltd Director Dakatra Ltd

Dr Kariem El-Boghdady MBBS BSc FRCA EDRA MSc
Consultant anaesthetist ,Clinical Lead and Research Lead, Guys and St Thomas
Senior lecturer Kings College London. Co founder and director Dakatra Ltd.

On Wednesday 28th July a lecture entitled "Respiratory Protection in dentistry" was organised by the Dental Association of Malta in conjunction with the Dental Faculty of the UOM.

The event was sponsored by Laboratories Kin (ProHealthLtd). Dr Edward Sammut was instrumental in engaging the speakers on our behalf.

The event was aimed at the multidisciplinary primary care dental team to help them grasp the current evidence and principles of

respiratory protection from airborne hazards in the dental setting.

The current principles behind current guidelines and evidence were presented. Practical and clinical considerations of hazard control systems as well as legal and ethical issues were discussed such as employers and employees responsibilities.

The differences between types of respirators such as FFP2, FFP3, reusable respirators and PAPR (loose fitting powered air purifying respirators) were described. 🙏



Drs Ann Meli Attard and Edward Sammut introducing the lecture



The Xara Lodge Event

17 August 2021

On Tuesday 17th August 2021, the Dental Association of Malta organised a lecture entitled "An update on Regeneration of Gum and Bone for Periodontology and Implant Dentistry" by:

Dr Mishal Sachdev BDS(Hons) MJDF RCS(Eng) MClintDent Perio MRSRCS(Eng), M(Rest Dent) RCRP(Glas) Cert Perio(EFp)AET Specialist in Periodontics and Implant Dentistry.

This was held at the Xara Lodge in Rabat and was kindly sponsored by AM Mangion, agents for Menarini (Keral).



Marina Fenech, Menarini Rep



Dr David Muscat introducing the speaker, Dr Sachdev



Dr Mish Sachdev delivering the lecture



Mish Sachdev, Simon Muscat and Ari Sachdev



Dr Sachdev with Marina and Sandra, Menarini Reps



An excellent dinner after the lecture at Xara Lodge

RESTORATION OF DENTITION USING LITHIUM DISILICATE CROWNS

IN A PATIENT WITH A HISTORY OF DENTINOGENESIS IMPERFECTA – A CASE STUDY COVERING AN OBSERVATION PERIOD OF MORE THAN 10 YEARS

Daniel Edelhoff Prof. Dr. med. dent. Polyclinic for Dental Prosthetics / Department of Prosthetic Dentistry, LMU Munich, Germany

Josef Schweiger Dental technician, M.Sc. Polyclinic for Dental Prosthetics, LMU Munich, Germany

Oliver Brix Dental technician, Innovatives Dental Design, Bad Homburg, Germany

The present case study describes the restoration of the dentition in a young patient whose teeth were generally malformed. The patient was fitted with CAD/CAM-fabricated long-term temporaries made of a high-performance polymer material.

This allowed the proposed restorations to be consistently monitored over an extended period of time while the patient was still growing. As a result, a high level of predictability of the permanent lithium disilicate restorations was established.



Fig. 1 Preoperative situation: The smiling patient. Serious damage had been caused by significant discolouration and unbalanced tooth proportions as a result of a condition known as dentinogenesis imperfecta type II.

PREOPERATIVE SITUATION

A 16-year-old patient presented to our practice in the company of his parents with the request that his malformed teeth be restored. He did not report any pain, but he complained about the emotional distress caused by the appearance of his teeth (Fig. 1).

During the dental examination, the patient's father mentioned that the primary dentition of the patient had shown the same type of damage. On the basis of the examination and the patient's history, he was diagnosed with non-syndromic dentinogenesis imperfecta.

This condition, which affects the dentin structure, is caused by a mutation on 4q22.1 in the dentin sialophosphoprotein (DSPP) gene (Lee et al. 2013). It changes the DSPP level, which disturbs the mineralization of dentin. Pulpal obliteration and changes in the jaw bone are furthermore associated with this disorder (MacDougall et al. 2006; McKnight et al. 2008; Porntaveetus et al. 2019).

The clinical presentation of the condition is a bluish, brown to amber colouring of the tooth enamel (Figs 2a and b). It cracks very easily under chewing forces, thereby exposing the defective dentin (Figs 3a and b). X-rays reveal



Figs 2a and 2b Preoperative situation: The severe damage of the tooth structure also caused functional impairments.

bell-shaped crowns and short roots with progressive obliteration of the pulp chamber (Gage et al. 1991, Kim & Simmer 2007) (Fig. 4).

Without treatment, the process of destruction rapidly leads to the loss of the entire tooth crown and a decrease in the vertical dimension of occlusion, which is difficult to correct orthodontically (Kim and Simmer 2007, Barron et al. 2008).

The literature refers to the importance of early intervention that aims at preventing the



Figs 3a and 3b Preoperative situation: View of the upper and lower jaw. The first molars of both jaws in particular show a high degree of destruction.

progression of tooth destruction and the deterioration of proper occlusion (Delgado et al. 2008, Sapir S, Shapira J.).

All-ceramic crowns are described as a potential restorative solution (Groten 2009), and adhesive cementation is recommended (Bartlett 2005).

This case presented a number of special challenges: for example, the young age of the patient (he was still growing); his desire for a timely improvement of his condition; the need for creating an appropriate tooth morphology and therefore the overall adjustment of the vertical dimension of occlusion (VDO) as well as the permanent attachment of the restorations to the damaged tooth structure.

TREATMENT PLAN

Before the treatment plan was finalized, fillings were placed in teeth 16, 26, 36 and 46 using an adhesive resin composite (Tetric EvoCeram, Syntac, Ivoclar Vivadent).

The dental team acted on the assumption that the malformed dentin would provide insufficient support in many areas. Against this background and because of the severe discolouration of the dentin, a minimally invasive approach with limited retentive preparation

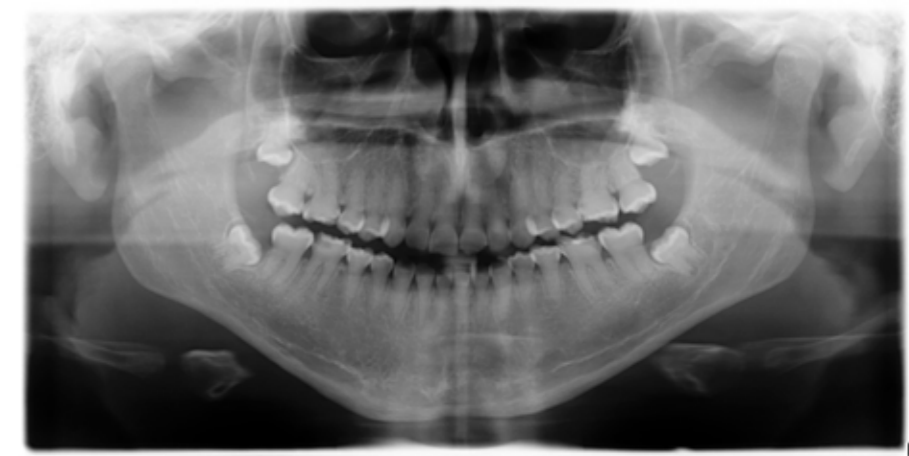


Fig. 4 Orthopantomogram of the preoperative situation: The relatively short tooth roots and the obliterated pulp chambers are clearly visible.



Fig. 5 Alternating determination of the maxillomandibular relationship. The long-term temporaries of one quadrant were removed to fabricate the permanent crowns. The maxillomandibular relationship was determined with a bis-acrylate-based temporary restorative material. This record was subsequently used as a reference for establishing the maxillomandibular relationship in the second quadrant.

and adhesive cementation was eliminated as a viable option.

In order to restore the esthetics and function of this young patient's teeth, the following treatment goals were defined: creation of an appropriate tooth morphology with anterior canine-protected dynamic occlusion and considerable increase of the vertical dimension of occlusion (VDO). The aim of these measures was to halt the destructive processes to which the teeth had been exposed, thereby allowing the patient to socialize comfortably again and enter the job market with confidence.

Extraoral (portraits) and intraoral photographs were taken to give the dental technician a first impression of

the preoperative situation. Alginate impressions of both jaws were made, which would enable the dental laboratory to fabricate study models.

Furthermore, the centric relation was established and an arbitrary facebow record was taken. After having closely analyzed the clinical and technical aspects and evaluated the risks and benefits of various alternative options, the clinical team together with the patient decided on the following treatment plan.

The goal was to permanently restore the severely damaged teeth with adhesively bonded lithium disilicate glass-ceramic crowns.

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RESTORATION OF DENTITION USING LITHIUM DISILICATE CROWNS

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Since these extensive esthetic and functional modifications had to be combined with the establishment of a new VDO, which had never previously existed, the clinical team decided on the following process:

1. Fabrication of a study wax-up to assist in the design of an esthetic and functional tooth morphology and the fabrication of a diagnostic matrix on the basis of the wax-up
2. Intraoral evaluation of the esthetics of the wax-up with the help of the diagnostic matrix
3. Reproduction of the raised VDO as determined with the wax-up in a modified Michigan splint for the functional evaluation of the new situation
4. Tooth preparation guided by the diagnostic matrix and alternating determination of the maxillomandibular relationship with a modified Michigan splint
5. Scanning of the wax-up and exact reproduction using CAD/CAM techniques to produce long-term temporaries made of a high-performance polymer
6. Trial of long-term temporaries (min. 12 months) with the possibility of making modifications
7. After the successful termination of the provisional phase, impression-taking and timely fabrication of the permanent glass-ceramic crowns in the dental laboratory
8. Try-in and permanent adhesive cementation of crowns made of lithium disilicate ceramic



Fig. 6a View of the LS2 restorations in the upper jaw following adhesive cementation (anterior teeth layering technique; posterior teeth staining technique). The anterior teeth were splinted in units of three. The posterior teeth were splinted in units of two.

CLINICAL PROCEDURE

Conditioning and preparation

Firstly, the study wax-ups were evaluated in terms of their esthetic appearance with the help of a composite-filled diagnostic matrix (Duran 0.5 mm, hard-elastic transparent, Scheu-Dental, Iserlohn, Germany), which served as a mock-up on the Vaseline-coated teeth.

Once the patient and his parents had approved of this restoration proposal, the preparation phase started.

The patient was provided with a modified Michigan splint for the lower jaw, which he had to wear for a period of three months in order to adjust his VDO in accordance with the wax-up.

After the trial phase had ended successfully, the new VDO was reproduced in a long-term temporary on the basis of the wax-up: All the preparations and the determination of the maxillomandibular relationship with a modified splint were scheduled for the same day.

The diagnostic matrix served as an orientation aid during the numerous preparation steps. Only minimal tooth structure was



Fig. 6b View of the LS2 restorations in the lower jaw following adhesive cementation. The crowns in the lower jaw did not need to be splinted. Single-tooth restorations were used exclusively.

removed in accordance with the outer contours of the restoration as determined by the wax-up.

TEMPORARY RESTORATION

The first temporaries were fabricated chairside with the help of the multiple-use diagnostic matrix and a bis-acrylate-based temporary restorative material. After the soft tissue had healed sufficiently, precision impressions were taken of both jaws.

The impressions together with the facebow and the maxillomandibular relationship record were sent to the dental laboratory. On the basis of scans of the study wax-ups, the laboratory milled the long-term temporaries from a high-performance polymer using CAD/CAM techniques.

The CAD/CAM-fabricated crowns of the long-term temporaries (LTT) were splinted in segments of 3 to 4 units and cemented with glass ionomer cement. The objective was to prevent the premature loss of retention as a result of the short abutment teeth and to ensure sufficient strength of the LTTs over a period of at least 12 months in situ.

Continues on page 36.

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RESTORATION OF DENTITION USING LITHIUM DISILICATE CROWNS

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During the temporization phase, the patient was initially recalled on a monthly and then on a quarterly basis in order to monitor the esthetic and functional parameters. At the same time, small tissue adjustments were made, and the crown on tooth 21 was surgically lengthened using oscillating instruments.

The evaluation phase of the LTTs proceeded smoothly. After 12 months, preparations were made to place the permanent restorations. In a first step, the maxillary provisionals were reproduced with the permanent restorative material.

For this purpose, the temporary restorations in the upper jaw were removed, the prepared teeth were finished and a maxillomandibular record was taken using a bis-GMA-based provisional restorative material (Fig. 5).

This record subsequently served as the reference for the determination of the maxillomandibular relationship in the second quadrant.

Next, precision impressions were taken for the fabrication of the permanent lithium disilicate crowns. In the period up to the incorporation of the permanent crowns, chairside-fabricated provisionals were used. After the glass-ceramic crown units had been placed in the upper jaw, the same procedure was used to place the permanent single crowns in the lower jaw (Figs 6a and 6b).

TRY-IN AND SEATING OF THE GLASS CERAMIC CROWNS

After the removal of the temporary restorations, residues of the temporary cementation material were cleaned from the



Fig. 7a New single crowns on the upper anterior teeth after trauma (knock with the rim of a beer mug). An opaque framework ceramic (MO Ingot, IPS e.max Press, Ivoclar Vivadent, Schaan, Liechtenstein) successfully masked the extremely stained tooth structure once again.



Fig. 7b Front view of the restorations after 10 years in situ at a recall appointment. The shade of the restorations impeccably masks the stained tooth structure. A successful result has been achieved in terms of the esthetics and function of the teeth.



Fig. 7c Palatal view of the restorations after 10 years in situ during a recall appointment

preparation surfaces with the help of brushes and a fluoride-free paste (Zircate Prophyl Paste, Dentsply, Constance, Germany). The restorations were tried in with

a shaded glycerine gel (Try-in Paste, Variolink II, white opaque, Ivoclar Vivadent, Schaan, Liechtenstein), and their shape and colour was examined. The marginal integrity and the

static and dynamic occlusal contacts were checked using a low-viscosity addition silicone (Fit Checker).

The restorations were permanently placed according to the following procedure. The inner surface of the lithium disilicate restorations was etched for 20 seconds with a hydrofluoric acid gel (<5% Ceramic Etching Gel) and subsequently silanized. The teeth were conditioned with a multi-step dentin adhesive according to the total-etch technique (Syntac).

The restorations were cemented with a dual-curing, low-viscosity luting composite (Variolink II, white opaque, Ivoclar Vivadent, Schaan, Liechtenstein).

The anterior crowns were produced with the layering technique, while the posterior crowns were pressed to full contour and characterized with the staining technique. The anterior crowns in the upper jaw were splinted in units of three (13-11, 21-23) and the posterior crowns in units of two (2 premolars and 2 molars each).

This approach was taken with the objective of obtaining suitable retention on the short abutment teeth in the upper jaw. Splinting of the crowns was unnecessary in the lower jaw due to the adequate length of the mandibular teeth (Fig. 6b). The extended pretreatment phase gave the dental team ample time to fine-tune the glass-ceramic restorations so that they would fully satisfy the esthetic and functional expectations of the patient.

LONG-TERM OBSERVATION OVER A PERIOD OF MORE THAN 11 YEARS

Just a few months after all the restorations had been permanently placed, the patient's upper crowns were damaged by a hard knock with



Figs 8a and 8b Postoperative situation of the full-contour upper posterior restorations more than 11 years after their adhesive cementation. A few minor grinding facets are visible on the functional cusps.



Figs 9a and 9b Postoperative situation of the full-contour lower posterior restorations more than 11 years after their adhesive cementation. A few minor grinding facets are visible on the functional cusps.



Fig. 10 Portrait photo of the patient more than 11 years after the permanent placement of the 28 LS2 restorations

the rim of a beer mug. The intraoral examination with a light probe revealed several extensive cracks in the splinted anterior crowns.

As a result, the patient and the clinical team decided to replace the crowns with single-tooth restorations (Fig. 7a).

Since these measures were taken, the patient has been regularly examined during recall appointments. No noteworthy complications have

been reported (Figs 7b and c). After more than 11 years in situ, the chewing surfaces of the full-contour posterior crowns show only slight grinding facets around the functional cusps (Figs 8a and b, 9a and b).

After 11 years, the patient is still completely satisfied with the function and esthetic appearance of his lithium disilicate restorations (Fig. 10). ■

Continues on page 36.

RESTORATION OF DENTITION USING LITHIUM DISILICATE CROWNS

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PROF. DR. MED. DENT. DANIEL EDELHOFF

Daniel Edelhoff granted his Certified Dental Technician degree from the Dental technician school in Düsseldorf, Germany. He graduated from Dental School in 1991 and earned his Doctor of Medical Dentistry degree from the University of Aachen, Germany in 1994.

He served as Visiting Professor at the Dental Clinical Research Center of the Oregon Health and Sciences University, Portland, Oregon from 1999 to 2001. He granted his Ph.D. in June 2003 at the University of Aachen and is currently Director and Chair at the Department of Prosthodontics and Dental Material Sciences at the Ludwig-Maximilians-University in Munich.

Daniel Edelhoff is board certified Specialist in Prosthodontics and holds membership in the German Society of Oral and Maxillofacial Medicine and the German Society Dental Prosthetics and Biomaterial Sciences (DGPro). He is member of the advisory

board of the DGPro, Associate Member of the American Academy of Esthetic Dentistry (AAED) and International College of Dentists (ICD), as well as Scientific Chairman of the 8th World Congress of the International Federation of Esthetic Dentistry (IFED) 2013 in Munich.

Daniel Edelhoff received in 2010 the award "Best Lecture" by the Association of Dental Technology (ADT), in 2011 the award "Best article of the year" by the Italian Dental Dialogue Journal, and in 2011/2012/2013 three awards "Best Teacher" by the dental students of the Ludwig-Maximilians-University and the Bavarian Association of Dentists.

Since 2014 he is Active Member of the European Academy of Esthetic Dentistry (EAED) as well as Associate Editor of the multidisciplinary international research journal *Clinical Oral Investigations*. Since 2016 he is the President of the German Association of Dental Technology (ADT).



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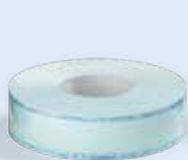
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