Best of British

Dental Tribune speaks with DLA Chief Executive Richard Daniels about the organisations latest campaign to promote British dental laboratories

It seemed appropriate to ask Richard why he felt there was a need for a campaign of transparency that effectively could by-pass the dentist in terms of offering patient information.

“The British Bite Mark campaign is like any other ‘Made in Britain campaign’, its aim is to provide the patient with an informed choice about their purchase, far from by-passing the dental practice, the campaign is going to actively embrace those dental practices that use registered British Bite Mark dental laboratories, over the coming months we will have information packs that dental practices can use free of charge to promote the fact that they use a British Bite Mark dental laboratory to their patients, thereby giving peace of mind.”

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In my opinion, dental laboratories that carry the British Bite Mark should be proud, dental practices that use British Bite Mark dental laboratory’s should be proud and we want to help them promote the fact to their patients, frankly if the DLA don’t promote British dental technology, who is?“
Tripping over triple trays

David Hands and Neil Photay shed some light on the pitfalls of using triple trays and how they could end up costing more than they are worth

The use of triple trays are becoming more common in the surgery to take an impression of prepared teeth (as well as opposing teeth) for the dental laboratory to prepare a fixed prosthesis such as a crown or bridge. With a thin, pliable mesh separating the impression material, the trays are used to simultaneously register the upper and lower bite. They tend to be seen by dentists as a cost-effective solution for taking impressions, but your dental technician may take a different view.

To prepare restorations of the highest quality and perfect fit, laboratories need to accurately register the patient’s bite. There is a very fine line between a perfectly fitting crown and one that causes the patient irritation - the difference can be a matter of millimetres. There are so many different techniques and products that a dentist can use to ensure they are taking impressions as accurately as possible, but in my opinion using a triple tray is not one of them.

Triple trays’ main downfall is that an impression of only four or five teeth is able to be taken. This makes it almost impossible for the technician to get a clear idea of the arrangement of the patient’s teeth, making it extremely difficult to create suitable restorations for them. Imagine being asked to cook a stranger their perfect meal, without being told which ingredients they don’t like! Essentially the chef is working blind, and this is the challenge dental technicians are faced with when they are sent impressions that are constructed using triple trays.

Along with the correct bite, technicians must also be able to assess the size and shape of the preparation margin and also of any adjacent teeth. The only way to do this effectively is to use stock trays which enable the dentist to take an impression of the full upper and lower arches. This really helps technicians to visualise for themselves how the patient’s bite, teeth and margin are formed.

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Triple trays can also be
awkward to use. I frequently have to ask dentists to retake their impressions after receiving a model which shows that the patient has bitten through the tray into the mesh. Avoiding this can be tricky and a lot depends on how much material needs to be used and how deep the outside of the tray is. Having said that, with the right technique triple trays can be successfully used for small inlays but I would avoid using them for anything more complex, such as bridgework.

Another word of warning: triple trays may at first appear to be the cost effective method of taking impressions but my experience tells me otherwise. With their lack of consistency and inability to take an impression of full upper and lower arches, impressions frequently have to be retaken. This involves rescheduling appointments at great inconvenience to both the patient and the dentist, costing time and, ultimately, money.

Dental Technology schools heed a warning regarding triples trays as a source of inaccuracy and therefore a higher rate of device failure. Some even go as far as refusing to work on triple tray impressions at all. Most laboratories will refuse to fabricate any bridge work on triple tray impressions, and rightly so, as the functionality of the bridge cannot be created or checked. If working only on the quadrant, the excursions of the full arch cannot be replicated which is essential information for the technician to have. Inevitably dentists may have to grind bridgework chair-side and create any guide planes by sight and feedback from the patient. Surely the cost of extended chair time is more than the cost of taking full arch impressions.

It can be very easy to become accustomed to using the system that you have done for years and it is understandable why at first clinicians might be loath to switch their impression tray. Nevertheless, I do believe that by using full arch stock trays, practitioners will benefit from more accurate restorations, a smoother service and an easier relationship with their laboratory. Likewise, the patient will receive an excellent restoration quickly and hopefully without having to return to the practice for a repeat impression.

‘With the right technique triple trays can be successfully used for small inlays but I would avoid using them for anything more complex, such as bridgework’

By taking full arc impressions, dentists won’t have to extend patient chair time

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Ultra Suction Denture Stabilisation System

Mony Paz and Ted J Carson discuss suction dentures

Ultra Suction system increases the retention of mandibular complete dentures. There retention capacity in comparison to conventional dentures has been positively demonstrated via retention tests and clinical observation.

A clinical study published in the EDA Journal (Jan. 2010 Vol. 56) shows a significant improvement in denture retention after the application of the Ultra Suction system. The aim of this article is to familiarise the clinician with the materials and methods through a comprehensive installation process.

Ultra Suction works on a simple mechanical principle: Suction. Two tiny one-way valves, embedded into the lingual or palatal aspect of the denture base, draw air from beneath the denture via two channels, collectively open to a retention chamber (Fig A).

As the wearer bites firmly, the air trapped between the mucosa and the denture is expelled through the valves. Under negative atmospheric pressure, the diaphragms seal off the valve inlets. The pressure difference, i.e., the lower pressure beneath the denture exerts a pull and draws the denture closer to the borders. The result is a better fit to the tissue and an improved resistance to dislodging forces (Fig B).

The documented dental literature teaches us that the supporting soft tissue under a well-crafted maxillary complete denture is subjected to -80mmHg of negative atmospheric pressure. This is the suction level experienced by upper denture wearers. Ultra Suction valves have been developed to generate the same negative force when applied to the mandibular dentures or palatalless maxillary dentures.

Ultra Suction works on a simple mechanical principle: Suction

The system is commercialised as a full kit with illustrative mounting instructions. The components may be used for upper or lower dentures, on completely new dentures or fitted on existing dentures during the rebase/reline pro-
System Components
The spacer bar is used to create a retention chamber. Made of malleable metal, the bar is designed to sit intimately against the ridge. It can be easily bent, burnished and adapted to almost any alveolar ridge. (Fig D).

Valves
Two one way valves designed to expel the air from beneath the dentures. The central hole in the valve body is described as the inlet, and the valve cover as the exhaust (Fig F).

Processing Caps
As their name suggests the caps are fitted onto the valve bodies before the instillation procedure. Their role is to protect the valves. They are removed only after the polishing stage (Figs G and H).

Diaphragms
Two diaphragms and two spares come with the kit. These tiny plastic discs seal the inlet under negative atmospheric pressure and release the pressure under resting conditions, at the rate of 10mmHg per 15 seconds (Fig I).

The service key has two extremities. The upper part is used to grip, close & open both the valve covers and the processing caps. The lower part is a slightly larger replica of the valve and may be used as a gauge for depth and diameter (Fig J).
the bar stopped at least 1cm short of the end of the denture (Figs 5-6). The bar was stabilised using two or three small drops of cyanoacrylate and any undercuts were blocked-out (Figs 7-8).

Hard base plates were prepared on top of the spacer bars (Figs 9-10), followed by bite blocks (Fig 11). After bite registration, the casts were mounted on an articulator (Fig 12) and teeth set-up for try-in was carried out (Figs 15-14).

In this case study the Agar flasking technique and cold cure acrylic was used. However, all other flasking and packing techniques are acceptable. Each model was packed in a two part flask (Figs 15-16). The spacer bar remained on the model and any undercuts were blocked-out (Fig 17). Cold cure acrylic poured in (Fig 18).

After polymerisation and de-flasking, the bars were removed from the dentures by digging prudently to prevent damage to the walls of the retention chamber (Fig 19-22).

The dentures were then trimmed and polished (Fig 25). It should be noted that if the valves are mounted before polishing the dentures, there is a high risk of ending up with protruding valve covers, which is not a favourable outcome in terms of patient comfort.

At the chosen lingual site, the location of the valves was drawn with a felt marker between first and second premolar, with the centre of the valve preferably 1-1.5 mm above the highest point of the retention chamber (Figs 24-25).

The cavities for the valves were prepared with a round bur (Fig 26) intermittently using the gauge side of the service key for guidance ie, depth and diameter (Figs 27-28).

Processing caps were then placed in the valves to protect the core from being filled with self cure acrylic and then tried in (Figs 29a-30).

The valves were installed with cold cure acrylic (Figs 51-52). Soft rubber cylinder points were used to remove excess material and to polish around the valves (Fig 53). The dentures were given a final sheen (Fig 54).

The processing caps were removed and the valve body inspected (Figs 55-56).

Using a 1mmØ fissure a communication channel was created between the valve and the high point of the retention chamber (Figs 57-58). For dentures with a significant thickness of acrylic between the valves and the retention chamber, drilling is done at an obtuse angle.

Each valve was rinsed and dried thoroughly to ensure a smooth placement of the diaphragm into its housing (Figs 59-60). The perforated cover was fitted and tied up using the service key (Figs 41-43).

Preventative maintenance

Practitioners were encouraged to recall their patients every six months. This shows that the clinician cares, thus increasing patient loyalty and also income stream.

A simple and efficient recall system developed by Fred Carson consists of a computerised patient database and a recall postcard printed on both sides (Figs 44-45). The patient's last visit was entered into the records. Six months later a pop up window displayed the names due for check-up. A postcard was sent. Most patients responded positively to this follow up.

During the biannual visit, dentures were checked for their fit to the supporting tissue, followed by a general examination of the oral cavity. On this occasion, calculus deposits were removed from...
around the retention chamber and the air channels were thoroughly cleaned (Fig 46).

The valve covers were opened over a receptacle of water to avoid losing the components. The valves were cleaned and the diaphragms replaced. Patients were instructed to clean their dentures and the valves on a daily basis. Patients who had manual dexterity were given the service key, together with spare diaphragms and were instructed to perform routine maintenance in between the biannual visits (Figs 47-51).

Discussion
Ultra Suction system appears to increase considerably the retention of complete dentures in both clinical observations and statistical findings. Their retentive capacity is superior to that of conventional dentures. The decrease in the rate of applied negative force by 10mmHg per 15 seconds, attributed to the design of the diaphragms, suggests that we may have a more tissue friendly denture than we first thought. It is well known that the supporting tissue is subject to -80mmHg under conventional maxillary dentures, which caused an increase in epithelial width in the palate and attached gingival, and a decrease in the epithelial width in the alveolar mucosa in most, if not all, complete denture wearers. The response is directly related to the functional demands of the tissue. In view of this documented evidence, it would be responsible to conclude that Ultra Suction’s negative force is less invasive that that of conventional dentures.

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References
As dentistry continues to evolve, new technologies and materials are continually being offered to the dental profession. Throughout the years, restorative trends and techniques have come and gone. Some material developments have transformed the face of aesthetic dentistry, while other initial concepts have phased out and died. Today all-ceramic restorations continue to grow in the area of restorative dentistry, from pressed ceramic techniques and materials to the growing use of zirconia, and new materials that can be created from CAD/CAM technology. This article will explore new uses for the all-ceramic material, known as lithium disilicate, and the use of a digital format to design and process this material in new and exciting ways. An overview of the material and unique clinical procedures will be presented.

Introduction

Embracing proven alternative solutions and transforming traditional methods can be challenging to dental restorative teams facing increasing patient demands while being tasked with delivering high-strength restorative options without compromising the aesthetic outcomes. Traditionally, dental professionals have used a high-strength core material made of either cast metal framework or oxide-based ceramic (such as zirconia or alumina). This approach has two disadvantages.

Compared with glass-ceramic materials, the substructure material has high value and increased opacity but may not be aesthetically pleasing. The zirconia core (with a 900 to 1,000 MPa flexural strength) is less than half of the cross-sectional width of a restoration; it must be completed with a veneering material with a flexural strength in the range of 80 to 110 MPa (depending on delivery method). The veneering material tends to chip or fracture during function. Also, such restorations depend significantly on the ability to create a strong bond interface between the dissimilar materials of oxide-ceramic and silica-based glass-ceramic, a bond that is not difficult to create. However, the quality of the bond interface can vary substantially because of cleanliness of the bond surface, furnace calibration, user experience and other issues.

In today's industry, monolithic glass-ceramic structures can provide exceptional aesthetics without requiring a veneering ceramic. Greater structural integrity can be achieved by eliminating the veneered ceramic and its requisite bond interface. This has been resolved through the development of highly aesthetic lithium-disilicate glass-ceramic materials.

The 70 per cent crystal phase of this unique glass-ceramic material refracts light very naturally, while also providing improved flexural strength (360 to 400 MPa). This gives more indications for use and the ability to place restorations using traditional cementation techniques, while also having strength and aesthetics.
With a monolithic technique (Figs 1 & 2), most restorations built from lithium disilicate materials can be completely fabricated. This approach provides high strength and aesthetics but requires surface colourants for the final shade. When in-depth colour effects are needed, a partial layering technique may be employed. Although no longer a purely monolithic structure (Figs 3 & 4) because the restoration maintains a large volume of the core material, the resulting restoration should reasonably maintain its high strength. However, no evidence supports this.

**Aesthetic options**

If covering or masking underlying tooth structure is part of the treatment plan, the restorative team can imagine doing so in an aesthetic way. The ceramist can make that vision a reality with IPS e.max (Ivoclar Vivadent) by using a very high opacity ingot. Ingots available for IPS e.max include high opacity (HO), medium opacity (MO), low translucency (LT) and high translucency (HT). The MO ingot can be used as an anatomic framework material if restorations must be fully layered. LT ingot can be employed with stain and glaze methods or hybrid layering techniques, which have been used for years with IPS Empress Aesthetic (Ivoclar Vivadent). The HT ingot is meant for stain and glaze techniques.

Choosing one of these four different aesthetic options depends on the preparation and the technique to be used in order to match the adjacent dentition or restorations. In addition, the laboratory can select the processing choice that is appropriate for the selected restoration. IPS e.max includes press and CAD/CAM options because lithium disilicate can be pressed from ingot form or milled from a CAD/CAM device.

**Preparation options**

If LT or HT ingots will be needed, then dentists can have flexibility with their preparations because of the translucent margins. This is the situation with partial preparations (for example inlays, onlays and veneers). The margins can be placed wherever clinically proper. IPS e.max’s translucency enables dentists to place the margins virtually anywhere on the restoration, blending seamlessly with the natural dentition.

Dentists can use a traditional preparation of 1.0 to 1.5 mm reduction (for example a full-crown preparation) if they need more opaque materials (for example HO and MO). Because the resulting restoration will have a slight opacity, the margins will be equi-gingival or slightly subgingival. In either case, the material will be fully layered to create the final restoration. IPS e.max provides the choice of using traditional or creative preparation designs.

**Cementation options**

Because lithium disilicate can be fully light-cure bonded or cemented using a self-etching primer with conventional resin-cement techniques, IPS e.max also provides options for cementation. Conventional self-etching primer cement is ideal for full crowns. For partial and veneer preparations for which adhesive protocol will be used, full-light-cure bonding is preferred.

**Case study**

A 42-year-old female presented with discoloured teeth that had been repaired with veneering ceramics without requiring a veneering ceramic.
various composite restorations placed throughout the years (Fig 5). A lingual amalgam restoration in tooth #12 and composite restorations in teeth #25, 21, 11 and 15 showed recurrent decay that was diagnosed with digital X-rays. She possessed a negative medical history and good oral hygiene with resultant periodontal health and asymptomatic teeth. Treatment options of zirconia or porcelain-fused-to-metal crowns or CAD/CAM all-ceramic restorations were discussed with the patient.

Ultimately, CAD/CAM all-ceramic restorations were tested. When proper preparation and occlusal design considerations are followed, properly placed CAD/CAM-designed and -milled restorations have been extremely successful. The patient made a preparation appointment, during which the existing restorations were removed, and teeth #25 to 15 were prepared for all-ceramic veneer restorations, following accepted CAD/CAM glass-ceramic preparation guidelines (Fig 6): adequate clearance, rounded internal aspects, and equi-gingival butt-joint margins were ensured. Once the preparations were completed, conventional impressions were taken and poured in high-quality, laser-reflective dental stone.

Laboratory communication
The dentist is to the dental technician what the architect is to the builder. Each has a primary role in indirect restorative dentistry, which is to imitate natural function and aesthetics perfectly and translate that into a restorative solution. The communication between the clinician and technician entails a thorough transfer of information, including functional components, occlusal parameters, phonetics, and aesthetics, and continues throughout the restorative process, from the initial consultation through treatment planning and provisionalization to final placement.

The primary and conventional communication tools between the dentist and technician are:

- Photography
- Written documentation
- Impressions of the patient’s existing dentition
- Clinical preparation
- Opposing dentition

This information is used to create models, which are mounted on an articulator to simulate the mandibular jaw movements.

Traditional indirect restorative process
The indirect restorative process involves the following steps:

1. The clinician prepares the case according to the appropriate preparation guidelines, takes the impressions, sends these and other critical communication aspects to the laboratory, and the laboratory receives all the materials from the dentist.

2. Then, the impressions are poured, models mounted, and dies trimmed.

3. Appropriate restorations—layered, pressed, milled, cast, or combinations—are made.

However, as restorative dentistry shifts further into the digital era, clinicians must change their perceptions and definitions of the dental laboratory. Traditionally, a laboratory is the site that receives and processes patient impressions and returns the completed restorations to the clinician, who adjusts and delivers them to the patient. Similar to how the Internet has transformed the communication landscape, the possibility of using CAD/CAM restoration files electronically has spurred evolutions in the way dental restorative teams perceive and structure the dentist-laboratory relationship.

The digital process
When the E4D LabWorks system (D4D Technologies) was introduced in 2008 (Fig 7), it was the first computerization model to present a real 3-D virtual model accurately and account for the occlusal effect of the opposing and adjacent dentition automatically. It enables the user to design 16 individual, full-contour, anatomically correct teeth simultaneously. The device condenses the information from a complex occlusal case and displays it in a user-friendly format that allows clinicians with basic knowledge of dental anatomy and occlusion to modify the design. Once this has been completed, the information is sent to the automated milling unit.

The innovation of digitally designed restorations meant that some of the more me-
mechanical and labour-intensive procedures (for example waxing, investing, burn-out, casting and pressing) involved in the conventional fabrication of a restoration were essentially automated. The dentist and technician had a consistent, precise method to construct functional dental restorations.

A file is created within the design software for each patient. The operator can input the patient’s name or record number and selects the appropriate tooth number(s) to be treated. Each tooth’s planned restoration is checked (for example full crown, veneer, inlay and onlay). Lastly, additional preferences include material choices and preferred shade. System defaults that can be set ahead of time or changed for each patient are preferred contact tightness, occlusal contact intensity and virtual die spacer, which determines the internal fit of the final restoration to the die/preparation. All this information can be entered prior to treatment or changed at any time if the actual treatment differs from what was planned.

When the images of the preparation, provisional restorations and opposing dentition are captured, the computer has all the required information for preparing the working models, preparation and opposing model. The real 3-D virtual model is then shown on the screen and can be rotated and viewed from any perspective (Fig 8). In designing the restoration, the first step must be to define the final restoration’s parameters digitally. This is achieved by employing the opposing and adjacent teeth for occlusal interproximal contact areas and, finally, the gingival margins of the preparation.

Using input and neighbouring anatomic detail as a basis, the software will place the restorations in an appropriate position—but not to the clinically ideal location. Instead, the operator relies on his or her knowledge of form and function and experience to reposition and contour the restoration. As the crown’s position and rotation are fine-tuned, the software’s automatic occlusion application will readjust each triangular ridge and cusp tip—and the restoration’s contours, contacts and marginal ridges—employing the preferences and bite-registration information. The virtual restoration adapts all parameters in relation to the new position. Instantaneously, the position and intensity of each contact point is illustrated graphically and colour mapped, where it can easily be modified based on the operator’s and clinician’s preferences. Through a variety of virtual carving and waxing tools, customisation and artistry are also possible. These tools can be used to adjust occlusal anatomy, preferences and contours, reflecting actual laboratory methods. Each step in the process is updated on the screen; therefore, the effect of any changes is immediately apparent. For this case, three files were loaded into the computer software for restoration design. Scans of the preparations, provisional restorations and opposing dentition were joined to form a composite file that represented the patient’s oral situation accurately (Fig 9). Once the final virtual restorations have been completely designed (Fig 10), the milling chamber with the predetermined shade, opacity and size of the IPS e.max block is loaded, an on-screen button is pressed, and an exact replica of the design is produced in ceramic in a short time.

Glass-ceramics are categorised according to their crystalline structure. However, as restorative dentistry shifts further into the digital era, clinicians must change their perceptions and definitions of the dental laboratory.

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chemical composition and/or application. The IPS e.max lithium disilicate is composed of quartz, lithium oxide, phosphorus oxide, alumina, potassium oxide, and other components. These powders are combined to produce a glass melt, which is poured into a steel mould, where it cools until it reaches a specific temperature at which no deformation occurs. This method results in minimal defects and improved quality control (owing to the translucency of the glass). The blocks or ingots are generated in one batch, based on the shade and size of the materials. Owing to the low thermal expansion that results during manufacture, a highly thermal, shock-resistant glass-ceramic is produced.

Next, the glass ingots or blocks are processed using CAD/CAM-milling procedures or lost-wax hot-pressing techniques (IPS e.max Press; Fig 11). The IPS e.max CAD blue block is based on two-stage crystallisation: a controlled double nucleation process, in which the first step includes the precipitation of lithium-metasilicate crystals. Depending on the quantity of coluant added, the resulting glass-ceramic demonstrates a blue colour. This ceramic has superior processing properties for milling. After the milling process, a second heat-treating process is performed in a porcelain furnace at approximately 850°C, at which temperature the metasilicate is dissolved and the lithium disilicate crystallises. This results in a fine-grain glass-ceramic with 70 per cent crystalline glass matrix. The with two microstructures during processing, the IPS e.max CAD material demonstrates distinctive properties during each phase. The intermediary lithium-metasilicate crystal structure promotes easily milling, without excessive bar wear, while maintaining high tolerances and marginal integrity. In the blue stage, the glass-ceramic contains approximately 40 per cent volume lithium-metasilicate crystals that are approximately 0.5 μm. The final-stage microstructure of lithium disilicate gives the restoration its superior mechanical and aesthetic qualities. In this stage, the glass-ceramic contains approximately 70 per cent volume lithium-disilicate crystals that are approximately 1.5 μm (Figs 12-15).

The laboratory process
Once designed and milled, the IPS e.max ceramic restorations are then prepared for final aesthetic adjustments. After the milling stage has been removed, the technician defines surface texture and occlusal anatomy using diamond and carbide burs, carefully avoiding any alteration to the perfected occlusal and interproximal contacts. Afterwards, restorations are rinsed to remove surface debris and dried. Then, the milling blue restorations are placed in a conventional ceramic furnace for the crystallisation process. These restorations were digitally designed with an incisal cut-back design that will allow a minimal application of translucent ceramics to mimic the incisal effects found in nature. Contoured to final anatomic shape, the restorations are further aesthetically improved by subtle colouring and glazing.

Restoration placement
Next, five per cent hydrofluoric acid (IPS Ceramic Etching Gel, Ivoclar Vivadent) was applied for 30 seconds onto the internal surfaces of the glazed restorations. Then they were rinsed and dried. This was followed by a silane coupling agent (Monobond-S, Ivoclar Vivadent), which was also placed for a minute onto the internal surfaces, and then air-dried. For the final cementation, Variolink Veneer (Ivoclar Vivadent) was used. After excess cement had been removed, final light-curing was done. The occlusal contacts were then reviewed and excursive pathway freedom was confirmed. Owing to the correct capture and alignment of the bite-registration information, few adjustments were required.

Conclusion
IPS e.max is about restorative options. Dentists and technicians now have a material with which they can do anterior or posterior restorations. With four different opacities or translucencies available, a variety of creative aesthetic options can be accomplished in a restoration. Dentists and their laboratory ceramists now have the opportunity to be more creative for their patients (Figs 16-18).

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

Fig. 12 Milled e.max full contour posterior restoration, shown in final crystallised micro-layered and glazed stage
Fig. 13 Milled e.max full contour posterior restoration, shown in final crystalised stain and glaze stage
Fig. 14 Milled e.max cut-back anterior restoration, shown in blue stage
Fig. 15 Milled e.max cut-back anterior restoration, shown in final crystallised micro-layered and glazed stage
Fig. 16-18 Maxillary anterior section restored with CAD/CAM-designed and milled e.max restorations, using a micro-layering technique for aesthetics

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