Dental implants: a different perspective part 2

The first part of this article, published in the February 2007 issue of *Implant Dentistry Today,* looked at the history of implant dentistry in the UK and worldwide, as well as evaluating patient satisfaction, why dentists get involved and then on the clinical side, Dr Haswell illustrated with case studies, the basics of implants, discussing in detail alveolar bone and bone substitutes. This time, Dr Haswell looks at abutment levelling, abutment tightening and occlusion

Restorative procedures and occlusal concepts

When considering implant usage both in the UK and worldwide the vast majority of patients receive either one or two implants. This means that most patients receive either a single implant supported crown or possibly a short span bridge or alternatively an implant retained overdenture. All of these types of restoration should and could be predictably supplied by adequately trained and informed general practitioners[1]. Within this article we will limit ourselves to the provision of single implant support crowns using impressions of previously placed implant abutments (posts) and the impression techniquess of the implant level.

Solution one – abutment level impression

With this concept the patient is returned to the general practitioner having had:

- Planning
- Surgical implant placement
- Abutment connection (permanent connection of the implant post to the implant)
- The fitting of a temporary protective cap or provisional restoration.

The benefits are that it requires virtually no implant equipment e.g. torque wrenches and it uses conventional crown and bridge impression techniques.

Abutment level impression

The patient will be returned from the implant

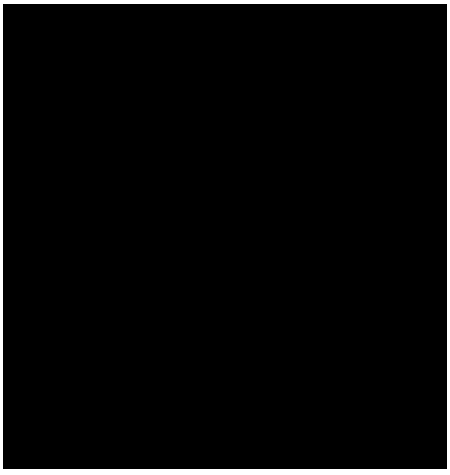

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Figure 17: Healing cap over Easy Abutment

Figure 18: Lateral view of Easy Abutment in situ

Figure 19: Snap on coping

Figure 20: Trimmed implant coping for Easy Abutment in situ

Figure 21: Impression technique using special centix mixing tip plus light and heavy impression material

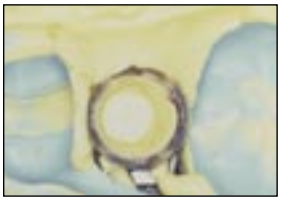

Figure 22: Impression snap on

Figure 23: Final crown in situ: lateral view

Figure 110: Custom gold posts and Procera crowns

Figure 111: Custum abutments in place

Figure 112: Final Procera crowns in place

Figure 51: Titanium abutment and crown

Figure 54: Abutments in position

Figure 93: Temporary crown in situ

Figure 94: Ceramic abutment in situ ready to have abutment level impression

Figure 95: Procera coping to be used as impression coping

Figure 96: Coping fitted over abutment ready for impression

centre with a previously installed abutment. Abutments fall into two basic categories for cementable single crowns which is by and large the norm for contemporary implant practice.

1. The abutments are either prefabricated by the manufacturer with components to ease the impression procedure (Figures 17-23) or alternatively areor customised abutments. These are manufactured or adapted from stock abutments either laboratory-prepared and customised gold abutments or alternatively CAD-CAM produced titanium or zirconia abutments (Figures 110-112, 51, 54, 93-97). Any of these will be fitted by the implant centre and fitted with an interim protective cap either in the form of a prefabricated protective cap or alternatively a provisional crown restoration (Figures 93-97).

2. The impression procedure within the general practice should take place after sufficient time for soft tissue maturation. This will need to be determined by the implant surgeon depending on the procedures that have been used.

At this stage the aim of the procedure is to take an accurate location of the position of the implant abutment in relationship to the adjacent teeth and gingival tissues and an accurate recording of the opposing arch. Below I have detailed two examples the first is with an Easy Abutment (Nobel Biocare) the second is with a customised gold abutment fabricated by a dental technician.

Easy Abutment: appointment one

Stage one is to remove the temporary protective healing cap with a small uni-grip screwdriver. (Figure 17)

Stage two: first fill the central screw hole with the supplied rubber bung or soft wax Is (then fit into position by pushing the impression coping over the abutment the plastic impression coping). The plastic impression coping should snap cleanly into place. (Figures 19 and 20).and fill the central screw hole with the supplied rubber bung or soft wax.

Stage three is then to choose a rigid sized stock tray to fit over the teeth and the coping with no interference or contact.

Stage four is then to syringe in to the impression coping a light body material of an addition cured silicone or a polyether. At the same time as this the tray is loaded with a heavy body material or monophase material and a conventional crown and bridge impression is taken over the top of this (Figures 21 and 22). The press fitence of the impression coping which should remain firmly adhered within the impression material. The coping design will ensure adequate definition of the margins of the abutment.

Stage five will then be for the refitting of the

Figure 97: Components necessary for abutment level impression of customised impression

healing coping after first removing the screw hole filling. The impressions will be sent away to the laboratory for the fabrication of the restoration. Afterwards the 'Abutment' impression and the opposing impression should be sent to a laboratory trained in the use of the selected implant system. This is essential as a different techniques will be required to make the model and prepare the die, on which to make a standard crown.

Easy Abutment: appointment two

Stage six: at the fitting appointment, the temporary crown or healing cap should be removed. The crown should be tried in. Iit should be checked for accuracy of fit, contact points and occlusal contacts (please see section on occlusion). The crown will then need to be cemented.

Stage seven involves cementation. It is essential to protect the head of the screw (should the screw every need to be retightened). The easiest way to protect this head of the screw is to use soft wax over the top of the screw or alternatively preformed rubber bungs that are constructed by implant manufacturers, alternatively light bodied silicone that can be injected over the head of the screw or plumbers tape (Figures 57 and 58). Then cementation of the crown can be undertaken either with 'Temp-Bond' to ensure that access to the screw can be gained in the future or, a proprietary implant cement such as 'Improv' (Alvelogro Inc) or Premier (Premier Dental Products Co) or alternatively conventional crown and bridge cement such as zinc phosphate. Resin bonding cements and resin modified glass ionomers should be avoided as it may be impossible to remove a crown should the screw need attention in the future.(Figures 23 and 98)

Customised abutments and impression technique

Patient will be delivered back to general practice with a customised abutment in situ together with a provisional restoration over the top of this, to allow for soft tissue maturation and also guided healing of the soft tissues.

Figure 57: Filling of the screw access hole with PTFE tape

Figure 58: Obturated screw access hole

Figure 23 Final crown in situ: lateral view

Figure 98: Improv implant specific cement

At the first appointment it will be necessary for the dentist to record the position of the implant and customised abutment together with the soft tissue. This is performed utilising the supplied impression coping. This can be either of a resin design a metal coping and to form substructure of a porcelain bonded restoration or alternatively a ceramic coping to form the basis of an all ceramic restoration. (Figures 94-96)

A. Remove the temporary crown and clean and debride the abutment and remove any trace of temporary cement.

B. Fit into position the impression coping.

C. Take an impression of the coping and surrounding teeth and soft tissue and then of the opposing arch.

D. Re-fit the temporary crown after which the models and shade should be returned to the technician for the construction of the final restoration. At this point it should be noted the aim of the impression procedure is to have the coping securely locked into position within the impression and an accurate recording of the soft tissues together with the surrounding teeth. Any invasion of the impression material inside the coping will to show that the coping was not correctly seated.

At the second appointment fit the final restoration, this will be undertaken using the same procedure and it cements to the example above.

Implant level impressions (fixture head impression open tray)

This will provide the general practitioner with the opportunity to take an impression of the top of the implant and then in conjunction with the dental technician to design the abutment and the final crown restoration.

In this scenario the patient will be returned to the general practitioner with the implant in situ and a healing cap attached to the top of the implant.

Stage one will be for the construction of the implant level impression. It requires removal of the healing cap from the implant (Figures 24-26). The healing cap should be placed either

Figure 24: Healing abutment in situ

Figure 25: Ankylos healing abutment in situ

Figure 26: Healing abutment in situ

Figure 27: Torque wrench and screwdriver

Figure 29: X-rays showing healthy bone level

Figure 31: X-rays showing healthy bone level

Figure 28: Check the X-ray to ensure accurate seating of components to give record of implant bone levels

Figure 30: X-rays showing healthy bone level

Figure 32: Open tray impression with screw hole visible

Figure 33: Fixture head impression of a Straumann implant

into sterile saline or Corsodyl (GSK UK) once it has been unscrewed from the implant using a hand screwdriver (Figure 27) during the impression procedure.

A correctly sized impression coping should then be fitted to the implant (Figures 33 and 35) and the accuracy of fit should be checked with an X-ray (Figures 28-31). This will also ensure that the practitioner has a baseline recording of the bone health and levels in and around their implant.

Figure 31 shows an open tray impression coping this is an impression coping that will protrude through a hole which is cut into either a special tray or alternatively a rigid stock tray. This requires a different impression procedure compared to normal crown and bridge. Once practiced is simpler and more predictable than most conventional crown and bridge impressions.

Once the accuracy of the location of the impression post has been checked and its tightness is ensured by finger tightening the screw. secured the impression post must be as finger tight This is achieved by using the small screwdriver (Figure 27), which will be provided by the manufacturer and or implant referral centre. The passive location of the tray with a small hole is then checked. Tthe tray should then be loaded with desired material with the dentist keeping one finger over the opening in the tray to prevent the impression material pouring onto the floor and to allow for the correct orientation of the tray as it will be possible for the dentist to feel the top of the screw protruding through the hole as he seats the impression tray into the correct position (Figure 32).

Once the impression material has set the impression screw must be released. The screw is undone until there are no bindings in the threads and then the post is withdrawn 1-2mm to ensure there is no overlap between the impression screw and the implant. The impression is then withdrawn and the healing cap is immediately fitted back into position as tight as is as achievable with finger pressure. The impression is check to ensure that the impression copings are securely held in the impression (Figures 36-38).

Design of the abutment and crown at this stage is done in conjunction with an experienced technician. The practitioner will need to decide on the type of abutment to be used and also the design and materials for the crown. As detailed above the abutments can be either prefabricated by the manufacturers or alternatively customised either by the laboratory or by the productions facilities such as Cares™ and or Procera™. Once the abutment has been chosen and adjusted or customised, the restoration can be constructed either of all ceramic material or alternatively conventional porcelain bonded to metal. (Figures 39-41, 110-112)

Appointment two involves delivery of the crown and abutment to the patient will be for the removal of the healing abutment and then be for the securing of the abutment. This is often achieved using a fitting jig to ensure the accurate orientation of the abutment this helps particularly the inexperienced practitioner as it (Figures 40 and 55).

Once the abutment has been secured and checked radiographically to ensure an accurate fit between the abutment and the implant head (Figures 62-64) with no intervening soft tissue or gap. The crown needs to be tried in to assess the fit, aesthetics and contour. Once both the patient and the practitioner are happy with this the abutment must be tightened into position.

Bold Abutment tightening

This is undertaken using a hand torque device. At this stage the torque device is connected to the screw and the screw is tightened slowly using the torque wrench, to achieveround at the prescribed torque these will be marked on the graduated scale of the torque wrench or designed into the device. (Note that these will vary depending on the manufacturer of the implant and should be checked to ensure that the screw is tightened optimally. Excess force could fracture the screw, while insufficient force will leave

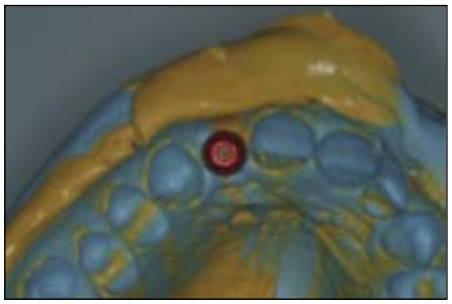

Figure 36: Impression of a Straumann implant

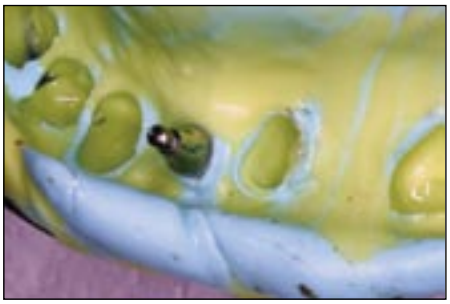

Figure 37: Successful impression of tooth and implant

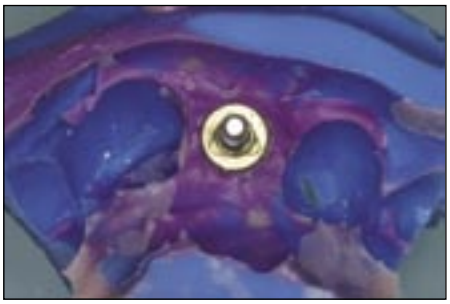

Figure 38: Completed impressions

Figure 39: Coping and fitting jig

Figure 40: Abutment and fitting jig

Figure 41: Packing moistened Bio-Oss (local anaesthetic)

Figure 110: Custom gold posts and Procera crowns

Figure 111: Custum abutments in place

Figure 112: Final Procera crowns in place

the patient with a potential weak screw joint prone to screw loosening. Once the adequate required torque is reached the screw should be left for two to five minutes before retightening to the same prescribed torque. This allows for the embedment relaxation of the screw and will allow the screw to perform optimally. (Figures 55 and 56)

Fill the abutment screw hole will be with either a soft wax, an impression silicone, a resilient material such as a gutta percha covered with a composite resin if so required or PTFE (plumbers) tape. (Figures 57 and 58)

This will prevent cement interfering with the screw head which could prevent access in the future.

Fitting of the crown can be done using either temporary cement (Premier or Improv), proprietary implant cement or alternatively a zinc phosphate type material. It is essential that when securing the crown excessive cement is not placed into the crown as excessive cement can and will be exuded into the gingival pocket. This can be difficult to clean resulting in implant cement residue around the implant head leading into peri-implant inflammation if left untreated. (Figure 99) It is also possible, if extreme amounts of cement are applied to the inside of crowns, for the cement to be forced down the side of the implant abutment down towards the implant. This is something to be avoided at all costs.

Figure 50: Reprobone synthetic allograft

Occlusion

Why is occlusion important to an implant restoration?

The implants successful healing to the bone creates a rigid fixation with virtually no movement (approximately five microns). However a healthy tooth will intrude by 28 microns[27] supported by the periodontal ligament. The periodontal ligament is the fundamental difference between the implant and the tooth.

The tooth is cushioned by the ligament, which acts as a shock absorber. The tooth also has a protective feedback from the periodontal mechano- receptors. Therefore, the presence of excess load (a high restoration) on a tooth will elicit a sensation from the patient. This may be as simple as the patient complaining that the restoration is 'high' and 'none of their other teeth contact' or it may create mobility or sensitivity in the tooth.

An implant doesn't have the cushion or the reflex. Therefore the patient will not detect the 'high' restoration. The implant will then experi-

Figure 62: Post fit check X-ray

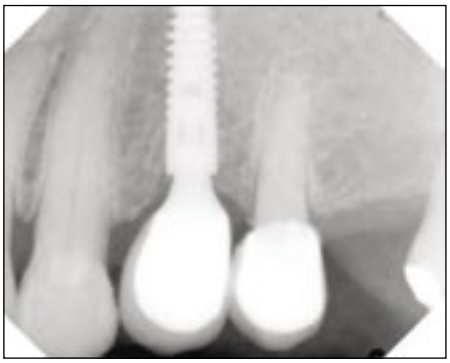

Figure 63: Post fit check X-ray

Figure 64: Post fit check X-ray

ence excessive load with little feedback. The implant does not have the physiologic adaptability to alter its position caused by its excessive load much as a tooth might or to report pain/discomfort centrally. The implant would therefore continue to be overloaded. Overload has been shown to be the major cause of implant failure.

It is the restoring dentist's responsibility to ensure that the implant is not exposed to excess load.[9]

The excessive force causes micro fractures in the bone – implant interface that cannot regenerate so they repair themselves with poorly differentiated scar tissue resulting in a soft tissue interface and ultimately a loose implant.

Occlusal perception is the ability of the patient to feel a sensation between the upper and lower jaw when a foreign body is between the occlusal surfaces. Here are the protocols:

- Tooth against tooth - 20 microns
- Implant against tooth - 48 microns
- Implant against implant - 64 microns.[30,28]

This shows that the implant restoration against a natural tooth will require the restoration to be twice as high before it will be detected.

Patients will have a reflex to avoid the high occlusal contact with teeth. However this will not happen with implants.

This fundamental difference between teeth and implants directs us to the fact that implants long-term health and stability is determined by carefully adjusted occlusal contaction. This is especially important, as the patient will be less well able to report any problems. Therefore careful assessment of contacts is essential for the adjustment of these contacts.

What are biomechanical the risk factors. Can we spot patients more at risk of overload?

i.• History of bruxism or clenching

Figure 55: Abutments torqued into position locating jig in position

Figure 56: Abutments torqued into position locating jig in position

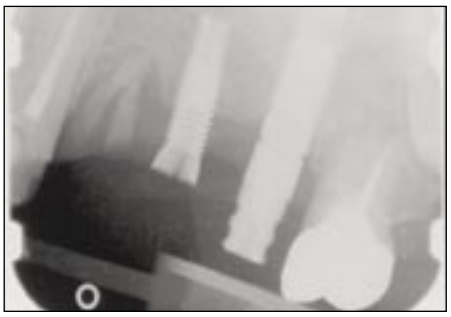

Figure 100: X-ray of split implant

Figure 101: Failure due to overload with split implant

ii.• Excessive guidance on restorations

iii.• Poor anterior guidance and disclusion in the dentition as a whole (making excursivex contacts more likely.

- History of fractured teeth.

Is it possible to reduce the effects of these risk factors:

1. Use of Nnocturnal occlussal splint

2.Design occlusal surface of restoration being the major guiding "tooth" in a particular movement path.

3. Adjust or restore the remainder of the dentition to allow stable contacts and protective disclusion[2].

4. Ensure sufficient guidance from the remainder of the dentition to prevent the implant restoration being excessively loaded in excursive movements.

Designing the implant restoration to withstand occlusal load needs avoidance of premature contacts on the implant-supported restorationsstoration.

This should entailsure all the natural teeth and implant restorations touching at the same time in centric occlusion.

However one additional factor has to be borne in mind. When teeth first contact they will compress into their socket move due to the

Figure 99: X-ray of crown whosing excess cement is on the distal surface of implant

Figure 102: Schimstock foil used to check the occlusal contact in centric occlusion on lower molar

Figure 103: Occlusal contacts on the lower first molar implant crown

Figure 107: Shows a narrow occlussal table molar crown on a wide diameter implant

viscoelasticity of the periodontal ligament. An implant will not! Therefore the implant will be left high by the movement of the teeth within the periodontal ligament!

Solution

Adjust the implant restoration – the implant crown should be adjusted with thin articulating paper (less than 25 microns, thin articulating paper 20 microns Acufilm: Parkell, Farmingdale, NY). The occlusion should be adjusted with the patient only lightly while tapping, their teeth together. There should barely be any contact when lightly tapping together. This can be verified by drawing through Schimstock foil (Hanel, Roeko) whilt the teeth are lightly held together. The same faoil should be held by the implant and opposing tooth when heavy bite forces are is applied (Figures 102 and 103).

The contacts should also be on the centre of the restoration thereby down the long axis of the toothimplant.

(Thin articulating paper 20 microns Acufilm: Parkell, Farmingdale, NY).

One must understand that despite the most accurate impressions and occlusal records all implant restorations will require adjustment to have an acceptable level of force when in functionrcation. This is because there is no way for a technician to allow for the compression of the periodontal ligament.

This pattern of occlusal adjustment does not mean that the opposing? The tooth has no functional contact. This periodic contact throughout thea dayss function will maintain the position of the opposing tooth within the occlusion.

Anterior teeth

We must also avoid excursive contacts on implant restorations in excursive movements. This will help avoid excessive or parafunctional forces on implants.

When posterior teeth contact in lateral movements they are subject to greater forces in lateral directions. The posterior teeth and implant restorations are much better at withstanding axial forces. The back teeth can be protected from these lateral forces if the anterior teeth disengage the back teeth from each other in lateral excursiveessive movements.

Can we ensure a reduced risk of lateral forces?

Check for adequate anterior guidance to create posterior disclusion prior to commencing treatment. Consider the creation or enhancement of anterior guidance to allow disclusion.

If an anterior implant is needed to aid in the disclusion (guidance) of posterior unit the guidance should be as shallow as possible to reduce lateral forces, said Weinberg[30].

The restoring dentist has the responsibility to minimise overload to the bone to the implant interface[18]. In the partially edentulous patient occlusal forces between teeth and implants should be harmonised[18]. Patients with a parafunctional habit should be provided with occlusal night guards, which will minimise destructive forces[18]. Avoid forces that do not go down long axis of the implant those would be excessive forces[18]. It is also important to avoid forces that do not go down long axis of the implant as these would be excessive forces, as they are multiplied by the cantlever effect. This is because the forces would be acting far away from the central line of support.

Forces away from the central axis of the implant will place the implant bone interface under sheetar and tension load which is disadvantageous to the bone. Ideally an implant should be loaded so that the implant bone interface is in compression.

Therefore the implant body should be perpendicular to the occlusal plane. The orientation of the implant. This is the responsibility of the implant surgeon. This is of primary importance when restoring single posterior units.

Should implant crowns be the same size as natural teeth?

The vast majority of implants placed will have a smaller diameter than the tooth they replace. Therefore to place a restoration the same dimension as the natural tooth will create overhangs (cantilevers), like placing an apple on a stick. This situation can result in tipping forces over the implant edge. These off-axis forces will tend to load the implant and bone in less advantageous ways. This can potentially lead to overload of the implant bone interface.

The solution is to have a narrower prosthesis especially in areas of high occlusal load i.e. molar replacements (Figures 102 and 107). This however does not take into account the mesiodistal dimension which must match the missing tooth. The occlusal contact should be over the long axis of the implant body. Contact at the mesial and distal marginal ridges should be carefully adjusted to relieve multiplying forces, far removed from the long axis of the implant especially in areas of high load. (ie. The occlusal contact should be straight down the screw holding the abutment to the implant). (Figure 103)

Advantages of narrow occlusal tables

i) Greater force concentration (like a sharp knife)

ii) Reduce off axis loads (tipping and twisting forces)

iii) Less risk of veneer material fracture.

Risk factors for implant restorations:

1. History of tooth fracture
2. Bruxism

Figure 108: Failed anterior bridge 1|1

Figure 109: Replacement implant at 1|1 after immediate replacement and bone augmentation

Figure 110: Custom gold posts and Procera crowns

3. Molar restoration due to higher forces
4. Patients with poor anterior disclusion
5. Mal-aligned placed implants.

Are implants for everyone?

Not necessarily but they could be working in a team structure most patients can be treated by the general practitioner with the surgical input of the implant surgical centre. Team dentistry is illustrated in Figures 108-112.

Conclusions

1. A continue rapidly increase in demand for dental implants is likely to be seen in the UK.
2. There is likely to be a shortage of well trained willing or capable of providing the surgical services required for implant installation.
3. A network of general practitioners allied to our surgical centre will be able to provide far greater number of patients with implant-based restorations than dentists working in isolation.
4. General practitioners should be able to provide the vast majority of restorative solutions for their own patients requiring implant-based therapy.

Figure 111: Custom abutments in place

Figure 112: Final Procera crowns in plane

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Implants by author Mark Haswell and restorations by referring GDP Dr S Peter.