Replacement of Traumatised UL1 with Simultaneous Implant Placement & Guided Bone Regeneration (GBR) – A Case Report

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Fig.1

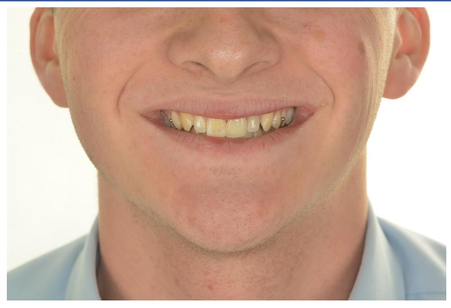


Fig.2


Fig.3


Fig.4

Complaint: This poster documents the treatment of a 23-year-old male (Mr RBC) who presented to the Restorative Department with a history of pain and swelling associated with UL1 which was traumatised at the age of 7 with a complicated crown fracture (fig.1-3). The tooth was root treated and restored. The patient became aware of discolouration of UL1 and a persistent dull ache following replacement of the composite restoration with a lithium disilicate crown. Symptoms had recurrently subsided and returned, however there were no acute symptoms at presentation.

Social history: Mr RBC was a non-smoker, did not drink alcohol and worked as a forensic scientist.

Dental history: The patient was a regular dental attender and brushed his teeth twice daily with a fluoridated toothpaste and round head oscillating toothbrush, and no other oral hygiene aids.

Medical history: The patient was medically fit and well with no regular medications or allergies.

Examination: Extra-oral examination revealed a skeletal II pattern with a reduced Frankfurt mandibular plane angle. There was no obvious asymmetry. There was no pathology associated with the temporomandibular joints or muscles of mastication. Mr RBC had a normal smile line extending to the interdental papillae but not showing the labial marginal gingivae. The upper lip had normal tone but was associated with a short upper lip length.

Intra-oral examination revealed a draining sinus in the region of UL1. Soft tissues were otherwise healthy. BPE scores were 0,4,0 / 0,0,0 with a 9mm probing depth associated with the mesiopalatal aspect of UL1: this was attributed to a vertical root fracture that was evident on tactile examination. Plaque and calculus was present locally in this region. There was no mobility or recession. There was localised delayed bleeding on probing from UL2 and localised immediate bleeding on probing and suppuration from UL1. The UL1 site had 6mm of keratinised mucosa and a gingival level discrepancy compared to UR1 site. There was a low frenal attachment in this region.

The patient had a class II division 2 incisor relationship with an increased overbite complete to tooth. Mr RBC guided in group function on left and right lateral excursions. Protrusion was guided on UR1 and UL1. There was limited occlusal space at UL1 to accommodate a resin retained bridge RRB and preparation of UR1 would likely be required to prevent a significant increase in the vertical dimension and to achieve control over guidance.

Sensibility testing: Pulp sensibility testing using a cold test and an electronic pulp tester revealed normal responses from UR2, UR1 and UL2. UL1 was restored with a lithium disilicate crown which exhibited suboptimal margins and contour. The remainder of the dentition was unrestored. UL1 crown was labially positioning when compared to UR1.

Radiographic Examination (fig.4):

1. Localised bone loss associated with the mesial of UL1; this exhibited an angular profile.

2. A suboptimal root filling UL1 associated with length control apically and coronally, and condensation.

3. An immature root profile with thin dentine walls UL1

4. A well-defined and corticated radiolucency extending between the floor of nose, the mesial aspect of UL1 and the distal aspect of UL2 root apices.

Diagnoses:

1. Previously root treated UL1 associated with a root fracture and with a chronic apical abscess and buccal draining sinus.

2. Class II division 2 incisor relationship associated with retroclined upper incisors and limited occlusal space.

Prognosis:

1. Unrestorable UL1 associated with pain and infection.

2. Questionable restorative prognosis due to:

a. Limited occlusal space for a denture or RRB without preparation of UR1 as a bridge abutment.

b. An implant supported rehabilitation would require a late implant placement protocol to provide sufficient time for bony healing following resolution of apical infection. This site would likely require site augmentation.

Aims of Treatment:

1. Eliminate pain and infection.

2. Restore UL1 form and function.

3. Minimise trauma to the remaining dentition.

Challenges:

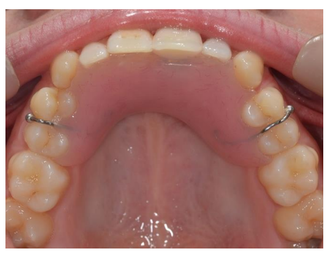
1. The size of the apical radiolucency associated with UL1.[1]
2. The increased overbite, and thus the occlusal space and guidance profile.
3. Retroclination of the upper incisors.
4. The predicted healing pattern with significant loss of buccal hard/soft tissue volume being likely.[2–4]
5. Loss of mesial bone with the associated challenges of achieving a papillae when restoring definitively.[5–8]

Treatment planning and options:
Short-term options to relieve pain and infection were to 1) monitor or 2) extract UL1 and replace with an immediate denture.

The definitive replacement options for UL1 were an 1) upper partial denture, 2) RRB or 3) an implant supported crown. The challenges, advantages and disadvantages of each of these options was discussed including the prosthetic space to accommodate various components of each rehabilitation, the treatment timespans and the likely need to augmentation the site with an implant supported rehabilitation.

Stage 1 (Acute)

1. Extract UL1 and fit immediate denture (fig.5).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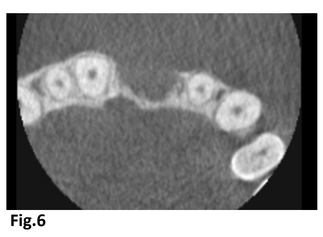
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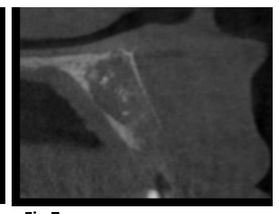
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Stage 2 (Prosthetic Planning)

1. Diagnostic wax up UL1 to assess feasibility of RRB and implant options.

2. Cone beam CT with radiograph stent (if appropriate) (fig.6-7).

An implant supported rehabilitation was selected as the preferred option by Mr RBC at this point. At a three month review the sinus had resolved. Whilst the defect was large, it remained three walled with good mesial and distal bone contour.

The case was planned for exploratory surgery with the aim of augmenting the UL1 site using autogenous bone particles (harvested locally) and deproteinised bovine bone material (DBBM) to provide support for a resorbable membrane. The aim was to achieve a bony contour that would remain stable following stabilisation of peri-implant bone, and to support gingival tissues. Implant placement was planned if sufficient apical bone was available during surgery to achieve primary stability.

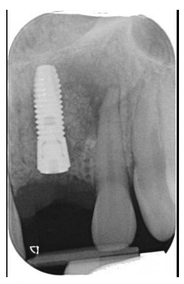
Fig.8

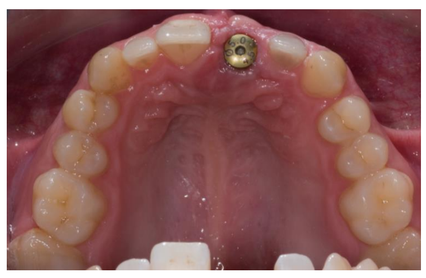
Fig.9


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Fig.11


Fig.12

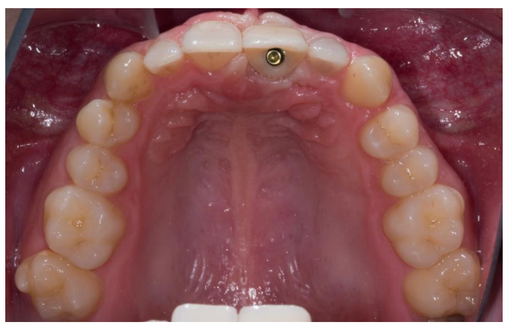
Fig.13


Fig.14


Fig.15

Stage 3 (Surgical Phase)

Implant placement with simultaneous GBR using autogenous bone particles, DBBM and bi-layered collagen membrane (fig.8). Conventional loading protocol with staged implant exposure (fig.9). Primary stability was evaluated clinically through tactility during implant placement and the insertion torque (45Ncm).

Stage 4 (Restorative Phase)

1. Provisional implant restoration using a screw-retained crown to refine incisal/labial contour, occlusion and tissue contour including emergence and papillae shape (fig. 10-12).
2. Definitive screw retained crown (SRR) (layered zirconia) with custom milled titanium abutment and employing an angulated screw access (ASA) to facilitate satisfactory support of incisal porcelain whilst also achieving adequate labial tissue contour and emergence (fig.13-14). Two year follow-up is shown in fig 15.

Discussion

The restorative rehabilitation of patients with increased overbites and retroclined incisors can be challenging due to a combination of limited occlusal space, guidance patterns and the influence of tooth orientation on prospective connector dimensions.[9,10] Optimising the timing of treatment was critical to maximise the feasibility of an implant supported rehabilitation and avoiding more extensive bone grafting. This case highlights the importance of thorough case planning including diagnostic wax ups to evaluate the restorative prognosis in this scenario. This is invaluable to assess the feasibility of achieving adequate connector dimension[11], a stable occlusal stop in ICP[10], avoidance of a heavily occlusal contact and excursions on the pontic[12], whilst also achieving a hygienic prosthesis.[13] The prosthetic and surgical challenges only became apparent following this process.

The large apical radiolucency in this case was challenging due to the impact of this on hard and soft tissue healing. The majority of the published literature reports healing in non-infected sites; predicting tissue healing following large areas of infection can be more challenging.[3,14,15] The available evidence suggests that horizontal and vertical loss of buccal bone is likely in this case given the radiographic thickness of the buccal bone.[2,3] Additionally, the extent of the apical radiolucency with buccal and palatal perforation of the cortical plate is likely to result in prolonged healing time.[1] Many of the risk mitigating measures such as alveolar ridge preservation[16–18] or early implant placement[4,5,19] are also contraindicated in scenarios where there is an active infective process. This case highlights the importance of assessing the shape (rather than simply the size) of the defect to determine the feasibility of site augmentation.[20–22]

The pattern of healing following trauma and periapical infection may result in loss of bundle bone (and consequently the buccal plate), but may preserve sufficient hard tissue support from adjacent sites and surface area to facilitate guided bone regeneration.[19,20] Whilst, at first glance, a block bone graft may be considered for optimal for this case, closure inspection of the records shows good bony support lateral to the defect. GBR was therefore considered feasible, however membrane selection was critical. Selecting the most appropriate material to fill the defect, as well as to act as a barrier, can be critical in such scenarios.[18] Whilst a range of materials are available to act as barriers to guide tissue ingrowth, the majority of biologically derived materials have unique resorption times and lack the ability to self-support and thus are more susceptible to the effects of biological compression.[23–25] Commonly utilised synthetic membranes can offer the ability to self-support, but are associated with a higher risk of membrane exposure[26,27] even when multiple materials/layers are utilised.[28,29] Membrane selection in this case was determined during surgery; BioGide was considered to be suitable after reviewing the width and height of the defect.

In this case, implant placement without the use of ASA would be a compromise between achieving a satisfactory contour of the labial tissues with an aesthetic and cleansable emergence, and a SRR. Achieving a SRR with conventional techniques would necessitate significant augmentation of the labial hard tissue contour to accommodate the dental implant. ASA enabled engagement of the remaining apical bone, whilst also facilitating the use of simultaneous augmentation, thus minimising the number of surgical interventions required. This was feasible due to the osteotomy characteristics (which can optionally underprepare the entire site, or apically) and the implant profile (cylindrical root form with minimal apical taper) employed in this case. Achieving optimal primary stability was critical in this case, as circumferential bone-implant contact would only be available in the apical third; less than ideal implant stability in such cases is associated with a higher risk of implant failure.[30] Utilisation of ASA has limitations which are specific to the Astra EV implant system. These relate to the necessity to accommodate the angulated screw housing within the implant abutment, thus requiring a more bulbous labial profile. This was planned in this case to control the soft tissue contour and achieve a symmetrical gingival level whilst also improving the cleansibility of the restoration. Additionally, this facilitated optimisation of crown contour to improve the incisal position discrepancy described with the previous lithium disilicate crown, whilst also ensuring adequate porcelain thickness and support. A custom base milled titanium abutment with a layered zirconia crown was utilised for the definitive restoration as this facilitated utilisation of an ASA. Utilising a digital manufacturing technique facilitated optimisation of the provisional restoration in the digital design workflow to ensure idealised abutment and core contours.[31] The hard and soft tissues remained stable at two year review.

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