

Lasers in orthodontics

In the second of their two-part series, **Rita** and **Arun Darbar** discuss 'trauma and orthodontics'

Introduction

During the summer months, traumatic injuries sustained in and around the playground are a frequent occurrence, especially in good weather (hot summer's day!). We have seen several cases from minor cuts and bruises to serious trauma with fractured to avulsed teeth. It would be great if all kids were to wear sports guards as a routine when they go out and play, however in reality this is not socially acceptable. As adults we too have a fair share of accidental injuries and trauma in and around the house or garden involving anterior teeth.

The main complications of trauma to the anterior teeth are loss of hard tissue tooth structure, pulp death, pulp calcification, ankylosis and external root resorption. In a luxation injury when the neurovascular supply to the tooth has been severed or damaged through trauma, some innate mechanisms for the revascularisation and reinnervation are present. However, 43% of extrusive luxation lead to pulp death within the first year with some calcification and root resorption¹ whilst 85-95% of intrusive luxation lead to pulp necrosis². Low level laser therapy is used in a variety of injuries including ischemic and hypoxic wounds for management of pain and to enhance outcomes^{3,4,5,6,7}. The mechanism of action involves upregulation of cytochrome c oxidase leading to increased energy for metabolism in neurons resulting in better survival of neurons following injury^{8,9,10} and activation of angiogenesis^{11,12}.

The two trauma case studies presented in this article were treated at Smile Creations Dental Innovations with the aid of lasers and orthodontics. Both cases sustained luxation injuries to upper incisors. The first case describes the management of trauma when undergoing orthodontic treatment and the second case presented for orthodontic alignment following trauma. Both cases received laser therapy during the orthodontic repositioning.

Case Study One

A 12-year-old boy, having recently commenced orthodontic treatment, fell off his bike and was brought to the practice within 30 minutes following the injury (Figures 1-2). At this point he was aware of other parts of the body that



Figure 1



Figure 2

Figures 1-2: Case 1, 30 minutes after the accident

were affected and traumatised but his main focus was the facial injuries and the damaged fixed appliance.

Extra oral examination – cuts and bruises to the skin, which was more significant on the right cheek and nose with swelling mostly on the upper lip. The patient was in pain and probably in shock but alert.

Intra oral examination – the upper right central and lateral incisors were extruded and mobile and the archwire .014 niti was still ligated and the bracket attached to the tooth. The upper right incisor was tender to percussion. The inner lip had puncture wounds where the brackets had traumatised the lip. The occlusion was checked and any obvious facial fractures were ruled out. Photographic and radiographic records (OPG scan was the preferred and more practical option – Figure 3) were taken and it was noted that the upper incisors did not indicate any root fracture.

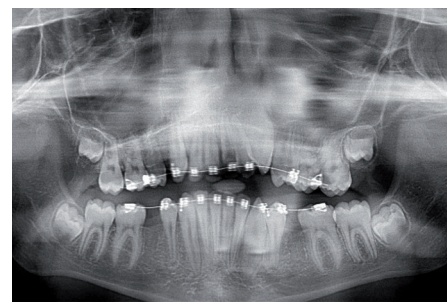


Figure 3: Case 1, OPG X-ray following accident



Figure 4



Figure 5

Figures 4-5: Case 1, three-day follow-up after accident and laser therapy

Treatment provided

As the patient complained of a burning sensation to the face where the skin had been abraded and the painful upper anterior teeth, laser therapy was used to reduce the pain. The protocols for the laser therapy were as follows: Diode laser, wavelength 810 nm using a diffuser handpiece to deliver 4.5 joules/cm². The application areas were; lower lip, upper lip, and apex of upper incisors, right cheek and tip of nose in a scan mode.

The archwire was undamaged and left to act as a splint and to gently intrude the upper right incisors. Within five minutes following the laser treatment the swelling had started to reduce and

the patient felt more comfortable and relaxed.

The patient was discharged with instructions to call us in case of any concerns or problems and re-booked for a review appointment three days later as per our standard laser therapy protocols. He was also advised he could take

paracetamol for pain relief if required in view of other injuries sustained in the accident.

A courtesy call was made the following day and the patient reported feeling much better and had been to the hospital after seeing us as he had bruised his ribs and to rule out any other injuries that may need medical attention and he was reassured by the A&E team.

The patient was seen three days later (Figures 4-5) and the laser therapy was repeated. He was advised to place wax on the anterior brackets to help with the lip healing. The patient was referred back to see his own GDP regarding the prognosis of the upper right incisors and a direct communication was set up to monitor this young lad's progress and outcomes between the two practices and their teams. The patient's mother informed us that the laser treated areas were healing better than the bruises he had received on his abdominal area that we did not treat with the laser.

The patient was seen five weeks later (Figures 6-7) for a routine appointment and the upper right incisors were now intruded but still tender to percussion (TTP). The colour was slightly darker on the central incisor, and the GDP had already warned the patient that he may need to have the tooth root treated. Both the upper right incisors were responsive to electrical pulp testing (EPT) though at very high settings indicating a very slow response. Laser therapy using the same protocols was used on the upper right incisors apically both labially and palatally to improve the neuronal and vascular repair at the apices and the periodontal ligament in an effort to rejuvenate to normal vitality.

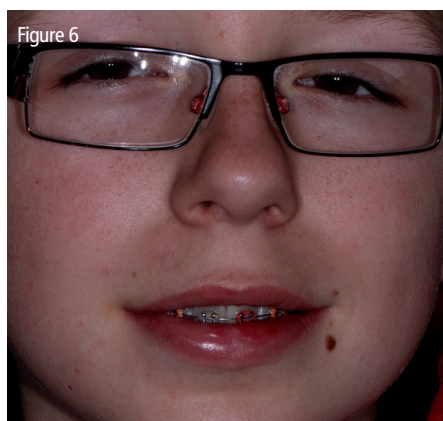
The healing on the cheek, lip and nose were uneventful and there was no scarring. The laser treatment was now only restricted to the upper incisors from this visit.

At six-month follow up (Figures 8-9) UR1 was vital and symptomless and radiographic examination showed that there was no periapical pathology. The patient's GDP also agreed to monitor the vitality of this tooth. At this visit the tooth was still responsive to EPT.

The patient completed his orthodontic treatment and it was possible to intrude the upper right incisors without losing their vitality.

The patient was reviewed 18 months following the trauma (Figures 10-11) and the upper right incisors were symptomless, had maintained their vitality and were responsive to EPT. Radiographic examination showed some resorption at the apex of the upper right lateral incisor (Figures 12-13).

The patient is on active monitoring with his own GDP and comes to us for reviews on a three monthly basis.



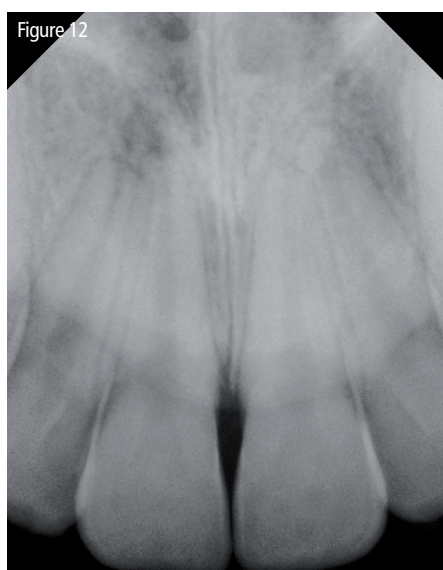
Figures 6-7: Case 1, five-week follow-up



Figures 8-9: Case 1, six-month follow-up



Figures 10-11: Case 1, 18-month follow-up



Figures 12-13: Case 1, PA X-rays taken at 18-month follow-up



Figure 14



Figure 15

Figures 14-15: Case 2, upon presentation and four weeks following the accident

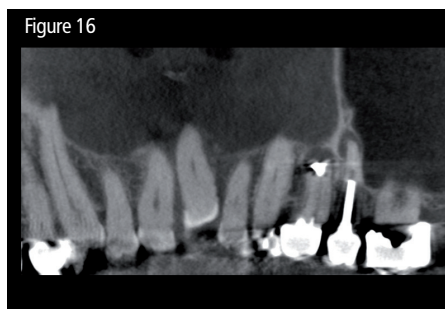


Figure 16

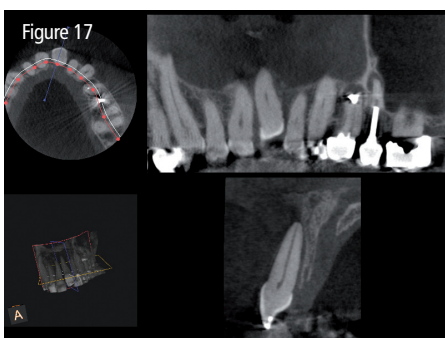


Figure 17

Figures 16-17: Case 2, 3D scans prior to treatment

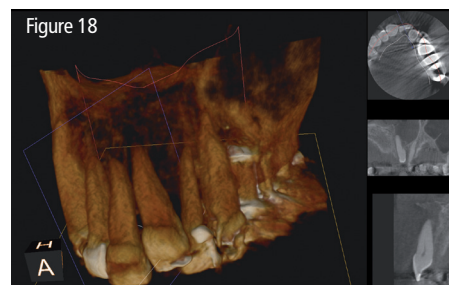


Figure 18

Figure 18: Case 2, 3D scan to assess damage

Case Study Two

A 69-year-old lady fell and sustained trauma to her upper left incisor, resulting in a luxation injury with intrusion of the tooth by 4-5mm (Figures 14-15). The patient thought she had fractured her tooth but her GDP informed her that it was intruded and she was referred for an orthodontic consultation as the emergency department at the local hospital had suggested that she could have the tooth extracted and replaced with a prosthesis. The prognosis of such an injury has severe complications, especially pulp necrosis, external root resorption and marginal bone loss 88-98%, 51-73% and 44% respectively^{2,13}.

Dental history – the patient attended her GDP regularly for dental check-ups, has a large number of restorations and missing lower right molars that have not been replaced but the patient felt that she functioned adequately and was not too concerned about the short comings of her dentition prior to the trauma, but now was very upset at the appearance of the upper left central incisor and wanted this tooth saved and preferably in the same position as before.

Medical history – this was clear and patient was fit and well. The patient was seen at the emergency department following the fall and was given the all clear for any

other injuries.

Extra-oral examination – no swelling or trauma to the face was evident.

Intra-oral examination – the patient's dentition was worn, and the upper incisors were imbricated and had restorations. The oral hygiene was poor as the patient did not want to disturb the tooth and the periodontal condition needed attention. The upper left central incisor was intruded and the gingival margin and papilla inflamed.

Radiographic examination – an OPG was provided by the GDP and a CBCT scan was performed to assess the extent of the damage (Figures 16-18).

Treatment options

The patient was informed that she could indeed have the tooth extracted and replaced as the prognosis of tooth survival were poor. However, the position of the tooth meant that the gingival margin would make it a difficult restorative challenge and both bone and gingival tissue grafting may be necessary to achieve an acceptable result, which would still be compromised in view of the existing malocclusion. Placement of implant was possible hypothetically but again space, bone and soft tissue architecture were questionable.

There would also be the financial

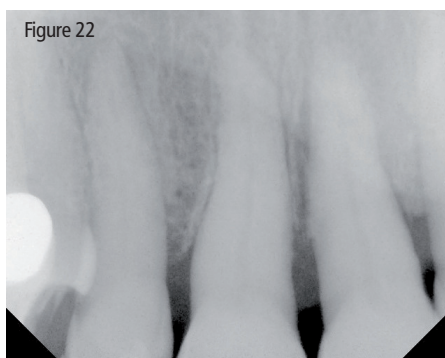
consideration for these treatment options. The other option was to orthodontically align the tooth and use laser therapy concurrently to improve the chance of survival for this tooth. The patient was warned that this may not be successful and she may need to have the tooth extracted or have root canal treatment. The patient wanted to give the orthodontic and laser therapy option a try.

Treatment provided

The upper labial segment was treated with a laser as follows: Wavelength 1064nm diode laser. Labial sulcus and gingival margins for 30 seconds each in a scanning mode. Following this, orthodontic brackets were bonded UR3- UL3 and sectional .014 niti ligated and the laser treatment repeated (Figures 19-20).

The laser treatment was repeated at two-week intervals as the tooth was very gently extruded for two visits, after which the patient was seen at four-week intervals. The tooth was extruded to where the patient said was the pre-trauma position which took 16 weeks in total. The patient wanted the orthodontic treatment to place the tooth back to its original position and did not want her malocclusion to be changed in any way.

The laser was used before debonding



Figures 19-20: Case 2, laser treatment following bracket placement

Figures 21-22: Case 2, six-month follow-up after accident

for pain management, settings as before, and then the brackets were debonded using the same laser at a different setting¹⁴. The excess composite was then removed and the patient fitted with a fixed retainer. The gingival margin appeared more aesthetic and the inflammation had subsided. The upper left central incisor was asymptomatic and slightly mobile. The tooth responded to EPT and a periapical radiograph showed no periapical pathology, no root resorption but some marginal bone loss distal to the upper left incisor (Figures 21-22).

At the three-month follow-up the upper left incisor was now firm and responded to EPT. There was evidence of plaque build up and oral hygiene instructions were given with particular attention to interproximal cleaning.

The patient was reviewed at 18 months and a periapical radiograph taken. There was no evidence of any pathology but some calculus present in the distal proximal area and the patient was referred back to her GDP to address this. The tooth was asymptomatic and firm and responded

to EPT. The patient is delighted with the outcome (Figures 23-24).

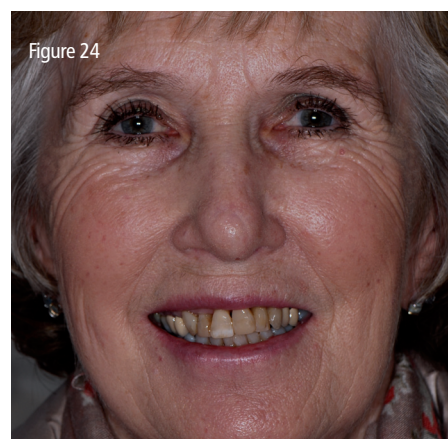
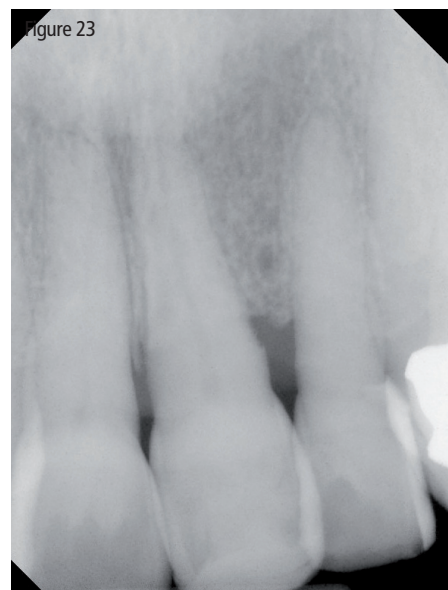
Conclusion

These cases of luxation injuries treated in our orthodontic practice with lasers have had good outcomes and particularly because no endodontic treatment was needed. Extrusion injuries lead to pulp necrosis, in most cases four weeks to 1.5 years¹⁵.

Intrusion injuries are relatively rare in the permanent dentition 0.3-1.9%¹⁶ hence we have limited regimes for their treatment. Guidelines available for the management of these injuries were followed when treating both patients.

The addition of laser therapy may merit consideration in further studies to improve outcomes, particularly as there is now enough scientific evidence for the effect of low-level lasers on cell survival.

Lastly, the vital tooth also has the best aesthetic appearance and reduces the need for any treatment intervention which has the complications of coronal leakage and risk of fracture¹⁷.



Figures 23-24: Case 2, 18 months later



Dr Rita Darbar runs her specialist orthodontic practice at Smile Creations in Leighton Buzzard, Bedfordshire. During her varied 30-year career in dentistry she has worked in the community dental services, general practice and hospital services. She has been interested in laser dentistry for the past 10 years and has talked on the subject internationally.



Dr Arun Darbar is a leading laser and aesthetic dentist based in Leighton Buzzard. He has been using lasers for over 20 years and holds advanced proficiency with the Academy of Laser Dentistry (ALD). Dr Darbar is an Accredited member of the British Academy of Cosmetic Dentistry and has won numerous awards including the Patient's Smile and Best Whitening case at The Smile Awards 2012.

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Case two summary



Figure 25: Pre op



Figure 26: Pre debond



Figure 27: Immediate post debond



Figure 28: One-month post op



Figure 29: One-year post op



Figure 30: One-year post op



Education aims and objectives

To gain an understanding of the main complications involved in cases of trauma to the anterior teeth, and the benefits of treating such injuries with the aid of lasers and orthodontics.

Expected outcomes

With the aid of two detailed case studies the reader will learn how to carry out laser therapy during orthodontic repositioning when treating severe luxation injuries. Subscribers can answer the CPD questions on page 82.