Dental Traumatology

Dental Traumatology 2012; **28**: 166–172; doi: 10.1111/j.1600-9657.2011.01048.x

Recovering the function and esthetics of fractured teeth using several restorative cosmetic approaches. Three clinical cases

CASE REPORT

Rodolfo B. Anchieta[1], Eduardo P. Rocha[1], Maurício U. Watanabe[2], Erika O. de Almeida[3,4], Amilcar C. Freitas-Junior[3,4], Ana P. Martini[1], Sônia R. P. Barioni[5]

[1]Faculty of Dentistry of Araçatuba, Department of Dental Materials and Prosthodontics, São Paulo State University-UNESP, Araçatuba, SP, Brazil; [2]Privative Dentist, Birigui, Sao Paulo, Brazil; [3]Faculty of Dentistry of Araçatuba, Department of Dental Materials and Prosthodontics, São Paulo State University-UNESP, Araçatuba, SP, Brazil; [4]Department of Biomaterials and Biomimetics, New York University, New York, NY, USA; [5]Faculty of Dentistry of Araçatuba, Department of Surgery and Integrated Clinics, São Paulo State University-UNESP, Araçatuba, SP, Brazil

Correspondence to: Rodolfo B. Anchieta, Departamento de Materiais Odontológicos e Prótese, Faculdade de Odontologia do Campus de Araçatuba, UNESP, Rua José Bonifacio 1193, CEP: 1601-050, Araçatuba, SP, Brazil
Tel.: +55 18 3636 3290
Fax: +55 18 3636 3246
e-mail: rodolfoanchieta2@hotmail.com

Accepted 25 June, 2011

Abstract – The teeth most commonly affected by trauma are the maxillary central incisors. The most frequent types of traumatic dental injuries to permanent teeth are enamel fractures, enamel and dentine fractures, and enamel and dentine fractures with pulp involvement. This article describes three clinical cases with different levels of traumatized maxillary incisors and several cosmetic approaches for recovery of the esthetics and the masticatory function, as well as the social/psychological aspects of treatment. All cases involved young adult men. The three clinical cases involve dentin and enamel fractures, dentin and enamel fractures with pulp exposure, and dentin and enamel fractures with pulp exposure associated with root fracture. The cosmetic treatments used to resolve fractures were direct composite resin by layering technique, indirect all-ceramic restorations (laminate veneer and ceramic crowns over the teeth), and immediate implant after extraction followed by immediate loading (ceramic abutments with ceramic crown over implant). In all three cases, excellent functional and esthetic results were achieved by use of these treatment modalities. The patients were very satisfied with the results.

The majority of dental trauma occurs in the maxillary anterior teeth (1). Crown fractures are the most common traumatic dental injury to permanent teeth (2), and the teeth most affected by trauma are the maxillary central incisors (3).

There are many causes for these such as falls, motor vehicle accidents, sports injuries, and violence; other causes may also exist, depending on a country's development and local habits (4–6).

The most frequent types of traumatic dental injuries to permanent teeth are enamel fractures, enamel and dentine fractures, and enamel and dentine fractures with pulp involvement (7–9). Many cosmetic treatments are available to regain dental esthetics, but if this trauma is not treated, personal problems can occur, such as difficulties in smiling, laughing, and eating, as well as emotional problems associated with public contact (6, 10).

The purpose of this report is to describe three clinical cases with different levels of tooth injuries and the restorative treatments carried out for each.

Case 1

A male patient, RCG, 21 years old, sought care at the dental clinic after a fall while biking, complaining that one of his teeth was broken. Clinical examination revealed that the left central incisor was fractured in the middle-third of the crown, involving enamel and dentin without pulp exposure (Fig. 1) and without signs symptoms of concussion or contusion.

Because there was a satisfactory amount of coronal tooth available, it was proposed to treat with a direct resin composite restoration to restore the fractured part. The patient chose to not have the diagnostic waxing of the left central incisor, and final restoration

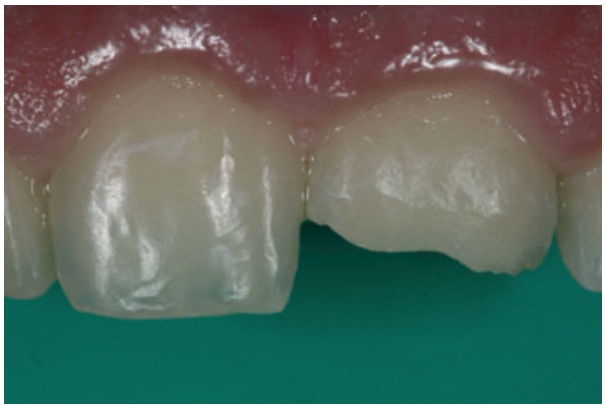

Fig. 1. Front view of fractured left central incisor.

using composite resin was performed in the initial consultation.

After cleaning the tooth with pumice and water, hybridization of enamel and dentin was performed using a two-step total-etch system (Adper Single Bond 2; 3M-ESPE, Sumaré, Brazil).

A multilayer technique with freehand sculpting was used to build up the restoration. The stratification began with an opaque dentin shade (A3D, Z350XT; 3M-ESPE) (Fig. 2), followed by the use of a more translucent dentin shade (A3B, Z350XT) to build up the dentin body. A translucent shade (CT, Z350XT) was applied to fill the gaps between the dentin mamelons and to create an extension of the restoration to the proximal regions and incisal edge (Fig. 3). To create a match with the superficial enamel, an appropriate enamel shade (A2E, Z350XT) was used to cover all the restored buccal surface. Because of dehydration, it was impossible to confirm whether the shade of the restoration matched the adjacent teeth immediately after finishing the sculpture. Therefore, a rubber point (Enhance; Destsply, Rio de Janeiro, Brazil) was used to minimize the surface roughness, and the patient was asked to make a follow-up appointment.

Two days later, the final finishing and polishing were performed with a 12-blade taper carbide bur, contouring and polishing disks (Soft-Lex; 3M-ESPE) and two systems of rubber points (Astropol, Ivoclar Vivadent; PoGo, Dentsply) (Fig. 4).

The final result was a natural look of the tooth restored (Fig. 5).

Fig. 2. Placement of the first and second layers of composite resin.

Case 2

An adult man, TM, 24, presented the clinical post-graduate dental prosthesis with a desire to improve the

Fig. 3. Note that palatal face was completed. The third layer of composite resin filled the spaces in the incisal and marginal edges.

Fig. 4. Complete restoration before polishing.

Fig. 6. Right central and lateral incisors with large composite resin restorations.

Fig. 5. Final restoration after polishing.

Fig. 7. X-ray of central incisor showing the treated canal root.

esthetics of his teeth. In the anamnesis, the patient stated that, as 22-year-old, he had suffered a fall because of an excess of alcohol, causing avulsion of the right central incisor, with a fracture of the tooth crown in the middle-third, with pulp involvement, crown fractures associated with the middle-third of right lateral incisor (enamel and dentin), and a crack of the left central incisor at the mesial incisal edge. The right central incisor was redeployed immediately after the accident and was immobilized by a rigid restraint. After a few days, an endodontic treatment was made for 11, and the fragment of 12 was reattached. Later, composite restorations were made in teeth 11 and 12 (Figs 6 and 7).

Under these conditions, two indirect restorations of teeth 11 and 12 were proposed, with 21 being left intact at the wish of the patient. The type of indirect restoration would be decided after the dental preparations were completed.

After removal of the entire composite resin that had teeth and preparation, the great loss of tooth structure in two teeth was evident, two all-ceramic crowns indirect having been chosen for esthetics and to maximize retention as the remaining tooth had great wear because of the large amount of resin composite that was present (Fig. 8).

Soon after preparation, the molding was performed and the color was selected. The provisional crowns were made with a bis-acrylic composite (Protemp 4; 3M/ESPE, Seefeld, Germany) with the help of the guide obtained by the silicone wax and diagnosis (Fig. 9).

The final crowns were fabricated with ceramic-based lithium disilicate (Fig. 10). After the crowns' proof, hydrofluoric acid etching (10%) was performed in the ceramics for 20 s, followed by silanization and adhesives procedures on enamel and dentin, and cementation of the restorations with resin cement (Variolink II, Ivoclar Vivadent, Schaan, Liechtenstein) (Fig. 11).

At 1-year follow up, the restorations remained perfect with no problems reported by the patient (Fig. 12).

Fig. 8. Remaining dental substrate after composite resin removal and dental reductions.

Fig. 9. Provisional crowns placed.

Fig. 10. Ceramic-based lithium disilicate crowns.

Case 3

The patient, a 25-year-old man, ASM, was introduced to clinical postgraduate dental prosthesis reporting his tooth had changed color.

Fig. 11. Immediately after resin cementation.

Fig. 12. After 1-year follow up, the restorations showed no signs of misfit or discoloration.

Clinical examination revealed tooth 21 was very dark. Furthermore, we observed that teeth 21 and 11 had extensive restorations of composite resin. In the anamnesis, the patient reported that at 15 years of age, he had suffered a fall while playing and had hit his front teeth. He reported that the two incisors were restored and that one had the root canal treated; there had been no other problems. Approximately 3 months ago, he suffered another trauma while playing soccer, and since then, the right central incisor had changed color (Fig. 13).

The diagnosis was the root fracture of 21 at the middle-third, as evidenced by radiography (Fig. 14). In element 11, there were no signs symptoms of trauma.

Initially, it was proposed to extract the left central incisor, with immediate implant placement and immediate loading with a provisional crown. After implant osseointegration, placement of a ceramic crown on based zirconia abutment for tooth 21 and a ceramic veneer on tooth 11 were planned.

After extraction of the fractured tooth (Fig. 15), the implant was placed and primary stability was achieved (45 N per cm). The provisional crown was immediately fabricated with a bis-acrylic composite (Protemp 4).

The treatment was resumed after the osseointegration time. The diagnostic impression was made, and the study models were overcast.

Fig. 13. Left central incisor changed it color after an incident of recurrent trauma.

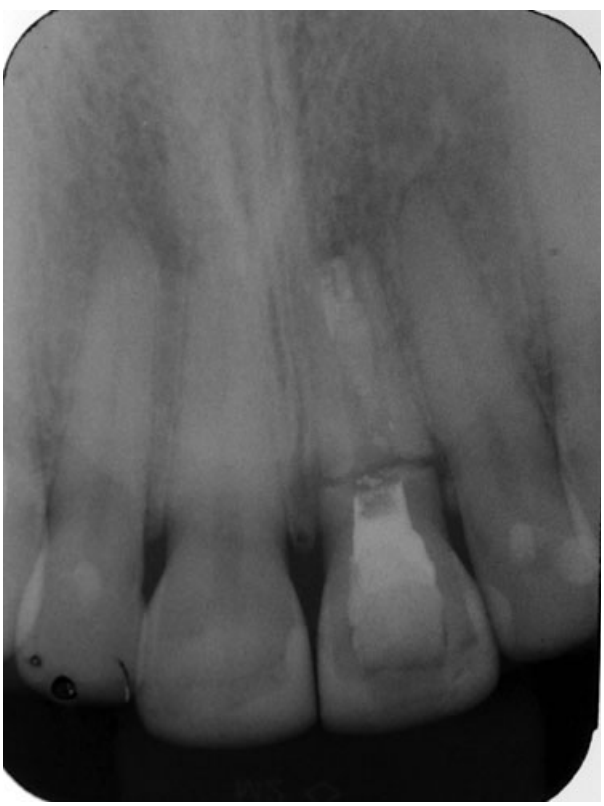

Fig. 14. X-ray of left central incisor, evidencing root fracture at the middle-third.

With complete tooth reduction, individualization of the square transfer technique was performed, and the molding was performed using two simultaneous retraction cords (# 00 and 0) and a polyether-based material (Impregum; 3M/ESPE, St. Paul, MN, USA) (Fig. 16). Then, after the color selection, the provisional crowns were made (Fig. 17).

With the restorations finished, the proof of the zirconia abutment was made (Fig. 18a), as were the crown on the implant (IPS e.max Press; Ivoclar Vivadent, Schaan, Liechtenstein) and the veneer (IPS e.max

Fig. 15. Fractured root during the operation.

Fig. 16. Molding and transfer impression.

Fig. 17. Provisional restorations placed.

Press). After the proof, the cement color was selected by the try-in kit (Variolink II Try-in) (Fig. 18b).

Before cementation, the crowns were etched by 10% hydrofluoric acid for 20 s and then the silane coupling agent (Prosil, FGM, Curitiba, Brazil) was applied, letting it dry for 1 min. A thin layer of adhesive system was applied and then polymerized. The abutment was placed with the first torque of 32 N per cm. The right central

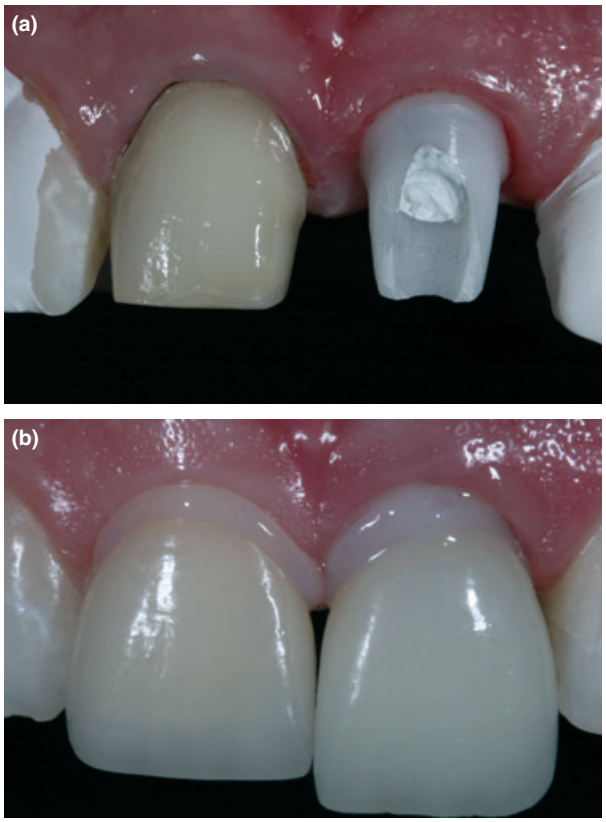

Fig. 18. (a) Proof of zirconia-based abutment, re-torque, and obliteration of orifice screw with teflon seals. (b) Cement color selection by the test kit.

incisor was etched by phosphoric acid (35%) for 15 s on the dentin and enamel. After the acid etching, a simplified 1-step adhesive was vigorously applied (Single Bond 2; 3M ESPE) and then polymerized, leaving no excess material.

The second torque (32 N per cm) was applied to the abutment, and afterward, the crown and veneer were cemented with resin cement (Variolink II).

Five days later, there was natural integration with the crowns and the gingival tissue (Fig. 19).

Fig. 19. Five days after the resin cementation.

Discussion

Tooth injuries are considered an increasing public health problem, unlike dental caries that have been declining over the last decades (11, 12). Most of the cases of trauma involve the anterior region of the mouth, affecting mainly the maxillary central incisors (13). Most cases occurred in adolescents and young adults men, which may be attributed to the fact this age-group usually has more intense social interaction and sports activities (13).

Currently, there are many treatment options for fractured teeth, and it is possible to restore function and esthetics using very conservative restorative techniques (13, 14).

In this presentation of clinical cases, three different restorative techniques were used to treat esthetic dental fractures, based on the type and extent of tooth fracture.

For fractures located in dental enamel or in enamel and dentin without loss of much tooth structure, the use of resin composites is an excellent alternative (15). Furthermore, the use of composites can be well suited for young people because it is a very conservative technique for performing repairs without reduction in healthy tooth structure. In a case study, we used a nanoparticles-based composite resin with the layering technique (15).

The use of contemporary composite resin with the layering technique allows restorations with nuances and shades of color similar to the adjacent dental structures. However, to achieve good results, this technique requires knowledge of the field of restorative material, knowledge of dental anatomy, and the manual skills to reproduce all the characteristics of the tooth (15).

In situations where there was great loss of tooth structure, the use of direct composite resins may not be the most appropriate therapeutic modality (16), because the restoration probably will not support the masticatory efforts, mainly because of the insufficient area for bonding (16).

In the second clinical case, in which the teeth were fractured, losing much of the coronal structure, we used all-ceramic indirect restorations.

Today, the improved mechanical properties of dental ceramics and the optical qualities of these materials have allowed the use of ceramics with esthetic predictability (17).

Moreover, some types of ceramics, such as those based on lithium disilicate, have mechanical and micromechanical adhesion to tooth structure through conditioning of the ceramics with hydrofluoric acid, a silane coupling agent, and subsequent bonding with resin cement (18). This makes retention of restorations possible, even when there is little coronal structure available, as was the situation in the second clinical case.

Other important features of the ceramics are surface smoothness and resistance to degradation (19). These characteristics enable color stability and integrity of the restorations over time (19). Moreover, these features contribute to the excellent response of gingival tissues, as provides an environment similar to the enamel with reduced aggregation of bacterial biofilms (20).

In complex cases of trauma with crown fractures, pulpal involvement, and root fracture, these teeth often cannot be restored. In those situations, basically two types of treatment are available to restore the function and esthetics: conventional fixed partial dentures over teeth and dental implant treatment and rehabilitation with fixed implant prostheses.

The approach for replacement of lost teeth is implant placement and prosthetic rehabilitation over the implants (21). Besides being a more conservative approach than the conventional fixed partial bridges over teeth, using the immediate implants technique with immediate loading allows quick replacement of the tooth lost (21).

Another important factor to be considered in replacement of anterior teeth, as with central incisors replacement, is the high level of esthetics achieved with the implant techniques. As in third the clinical case, the placement of implants immediately after tooth extraction, combined with immediate prosthetic load placement, enables the maintenance of alveolar bone height and architecture of the gingival tissues (21, 22), providing excellent, natural-appearing restorations (23).

In addition, the use of prosthetic components made of ceramics, as the zirconia-based abutments, makes possible metal-free restorations unnoticeable among the natural dentition, thereby making it possible to obtain satisfactory results even in complex situations, such as in cases of low keratinized gingiva (24).

Several therapeutic modalities with high esthetic potential are available to the dentist for treatment of fractured teeth or teeth lost by trauma, leaving the dentist able to choose the most appropriate therapy for each situation.

In conclusion, from a clinical standpoint, the three treatment modalities presented in this study provided good treatment outcomes and allowed good functional and esthetic outcomes for traumatized teeth.

Conflict of interest

The authors do not have any intuitional or financial support for the work.

References

1. Zerman N, Cavalleri G. Traumatic injuries to permanent incisors. Endod Dent Traumatol 1993;9:61–4.
2. Dietschi D, Jacoby T, Dietschi JM, Schatz JP. Treatment of traumatic injuries in the front teeth: restorative aspects in crown fractures. Pract Periodontics Aesthet Dent 2000;12:751–8.
3. Andreasen JO, Ravn IJ. Epidemiology of traumatic dental injury to primary and permanent teeth in a Danish population sample. Int J Oral Surg 1972;1:235–9.
4. Lin S, Levin L, Goldman S, Peleg K. Dento-alveolar and maxillofacial injuries: a 5-year multi-center study. Part 1: general vs facial and dental trauma. Dent Traumatol 2008;24:53–5.
5. Altay N, Güngör HC. A retrospective study of dento-alveolar injuries of children in Ankara, Turkey. Dent Traumatol 2001;17:201–4.
6. Santos SE, Marchiori EC, Soares AJ, Asprino L, de Souza Filho FJ, de Moraes M et al. A 9-year retrospective study of dental trauma in Piracicaba and neighboring regions in the State of São Paulo, Brazil. J Oral Maxillofac Surg 2010;68:1826–32.
7. Rajab LD. Traumatic dental injuries in children presenting for treatment at the Department of Pediatric Dentistry, Faculty of Dentistry, University of Jordan, 1997–2000. Dent Traumatol 2003;19:6–11.
8. Tapias MA, Jiménez-García R, Lamas F, Gil AA. Prevalence of traumatic crown fractures to permanent incisors in a childhood population: Móstoles, Spain. Dent Traumatol 2003;19:119–22.
9. Ivancic Jokic N, Bakarcic D, Fugosic V, Majstorovic M, Skrinjaric I. Dental trauma in children and young adults visiting a University Dental Clinic. Dent Traumatol 2009;25:84–7.
10. Cortes MI, Marcenes W, Sheuham A. Impact of traumatic injuries to the permanent teeth on the oral health-related quality of life in 12–14-year-old children. Community Dent Oral Epidemiol 2002;30:193–8.
11. Marcenes W, al Beiruti N, Tayfour D, Issa S. Epidemiology of traumatic injuries to the permanent incisors of 9–12-year-old schoolchildren in Damascus, Syria. Endod Dent Traumatol 1999;15:117–23.
12. Guinelli JL, Saito CTMH, Garcia Júnior IR, Panzarini SR, Poi WR, Sonoda CK et al. Occurrence of tooth injuries in patients treated in hospital environment in the region of Araçatuba, Brazil during a 6-year period. Dent Traumatol 2008;24:640–4.
13. Castro MAM, Poi WR, Castro JCM, Panzarini SR, Sonda CK, Trevisan CL et al. Crown and crown–root fractures: an evaluation of the treatment plans for management proposed by 154 specialists in restorative dentistry. Dent Traumatol 2010;26:236–42.
14. Ozel E, Kazandag MK, Soyman M, Bayirli G. Two-year follow-up of fractured anterior teeth restored with direct composite resin: report of three cases. Dent Traumatol 2008;24:589–92.
15. Sakai VT, Anzai A, Silva SM, Santos CF, Machado MA. Predictable esthetic treatment of fractured anterior teeth: a clinical report. Dent Traumatol 2007;23:371–5.
16. D'Arcangelo C, De Angelis F, Vadini M, D'Amario M, Caputi S. Fracture resistance and deflection of pulpless anterior teeth restored with composite or porcelain veneers. J Endod 2010;36:153–6.
17. Chen Y-W, Raigrodski AJ. A conservative approach for treating young adult patients with porcelain laminate veneers. J Esthet Restor Dent 2008;20:223–38.
18. Blatz MB, Sadan A, Kern M. Resin-ceramic bonding: a review of the literature. J Prosthetic Dent 2003;89:268–74.
19. Pires-de-Souza Fde C, Casemiro LA, Garcia Lda F, Cruvinel DR. Color stability of dental ceramics submitted to artificial accelerated aging after repeated firings. J Prosthet Dent 2009;101:13–8.
20. Aykent F, Yondem I, Ozyesil AG, Gunal SK, Avunduk MC, Ozkan S. Effect of different finishing techniques for restorative materials on surface roughness and bacterial adhesion. J Prosthet Dent 2010;103:221–7.
21. Koh RU, Rudek I, Wang HL. Immediate implant placement: positives and negatives. Implant Dent 2010;19:98–108.
22. Al-Harbi SA, Edgin WA. Preservation of soft tissue contours with immediate screw-retained provisional implant crown. J Prosthet Dent 2007;98:329–32.
23. Freitas Júnior AC, Goiato MC, Pellizzer EP, Rocha EP, Almeida EO. Aesthetic approach in single immediate implant-supported restoration. J Craniofac Surg 2010;21:792–6.
24. Sailer I, Zembic A, Jung RE, Hämmerle CH, Mattiola A. Single-tooth implant reconstructions: esthetic factors influencing the decision between titanium and zirconia abutments in anterior regions. Eur J Esthet Dent 2007;2:296–310.