case report

FRACTURES OF CROWN, ROOT AND AVULSION OF PERMANENT TEETH: CASE REPORT OF COMPLEX TRAUMATIC DENTAL INJURIES

V. DI TARANTO[1], M. SEVERINO[2], C. AGRESTINI[1], A. BARLATTANI[1]

[1] *Department of Clinical Sciences and Translational Medicine, "Tor Vergata" University, Rome, Italy*
[2] *Department of Life, Health and Environmental Sciences, University of L'Aquila, L'Aquila, Italy*

SUMMARY
Complete avulsion of permanent teeth represents 0.5-3% of all dental traumas. The replanting is the best choice for the survival of the avulsed teeth, but it is not always possible immediately after the trauma.
This case report described the complex management of a traumatic avulsion of two upper central incisors with a fracture of the apical third and the fragment was still in the alveolar socket.

Key words: dental avulsion, root fracture, splint, endodontic treatment, apical plug.

Introduction

Complete avulsion of permanent teeth represents approximately 0.5-3% of all dental traumas (1, 2).
Very often the replanting is the best choice for teeth survival, but it is not always possible immediately after the trauma. Obviously, it is necessary that there are no previous pathologies of the tooth or the supporting tissues (98).
The International Association of Dental Traumatology (IADT) has developed guidelines for handling dental avulsion cases (3-5). The IADT therefore confirms that, in the case of dental avulsion, there is indication for immediate replantation of the avulsed tooth, if, obviously, the patient's general health conditions are not compromised.
If it is not possible to proceed with the immediate replanting of the dental element, this should preferably be stored in milk (6), in a tissue culture medium, HBSS, saline or physiological solution. The tooth could also be transported inside the mouth, placing it inside the lips or cheeks, if the patient is conscious and there is no danger of inhaling or swallowing. It is absolutely necessary to avoid storing the tooth in water (7, 8). It is also clear that the treatment choice is related to the maturation of the root apex and the condition of the periodontal ligament cells (9, 64-95). In fact, if the avulsed tooth is kept in dry conditions for more than 60 minutes, the cells of the periodontal ligament will lose their vitality (10, 11).
Andersson et al. (2012), in their guidelines, for avulsed teeth with a closed apex recommend endodontic treatment between 7 and 10 days after replanting and before removal of the splinting (12-16, 96); while for the immature avulsed teeth the primary objective is to allow revascularization of the pulp space and allow the development and formation of the root apex (17, 18). If revascularization is not successful, the Authors recommend the endodontic treatment. Antibiotic therapy is recommended after dental replantation, and there are several studies that prove its validity (19-21). Many studies recommend tetracyclines as a first-choice antibiotic

(22-24), although the risk of dental discolouring is very high. In many countries, in fact, tetracyclines are not administered in patients under 12 years of age. Therefore, as a valid alternative to tetracyclines, many studies recommend amoxicillin (18, 24).

Case report

The 25th of May 2014, a 25-years-old male patient was visited in our emergency dental care unit at the "Tor Vergata" University Hospital in Rome. The patient reported he had a bicycle accident the night before and had only minor emergency care from a generic doctor that sutured only his upper lip.

Perioral region of patient's face presented excoriations on the skin of the nose, swelling and wounds on lips and chin region (Figure 1).

Intraoral examination showed the traumatic avulsion of tooth 1.1 and 2.1, tooth 2.1 was also missing the fractured apical third and the fragment was still in the alveolar socket. Teeth 1.1, 1.2, 2.1, 2.1 and 4.1 presented also coronal fractures with pulp exposure only on teeth 1.2 (Figure 2). The inferior jaw presented a profound soft tissue wound exposing the jawbone situated in the vestibular fornix and extending from tooth 3.3 to tooth 4.3. All clinical findings were confirmed by radiographic exams that confirmed the presence of the apical fragment of 2.1 *in situ* (Figure 3).

After local anesthesia with 1:200.000 articaine (25, 26, 97), the apical root fragment of 2.1 was extracted. The avulsed teeth, 1.1 and 2.1, were

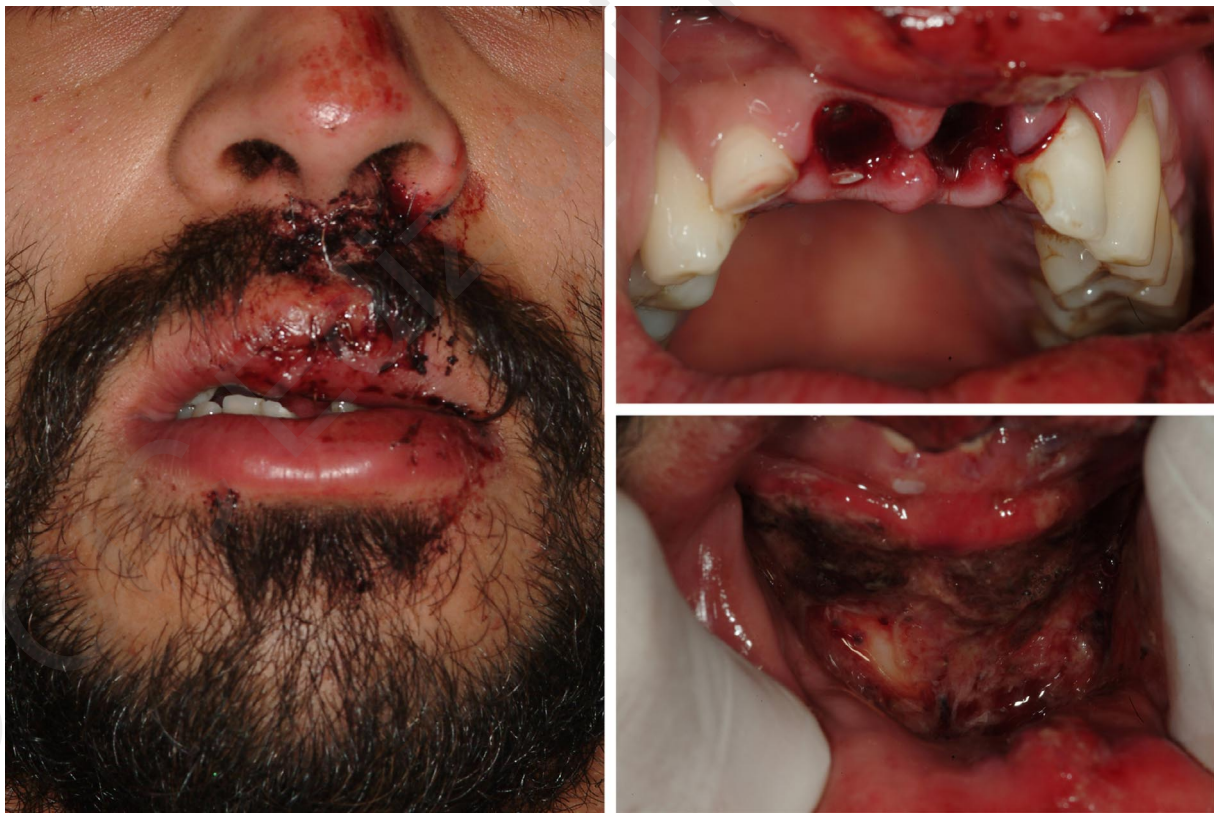

Figure 1
Images of the face and upper and lower arches at the first visit after dental trauma. Complete avulsion of teeth 1.1 and 2.1, and multiple coronal fracture.

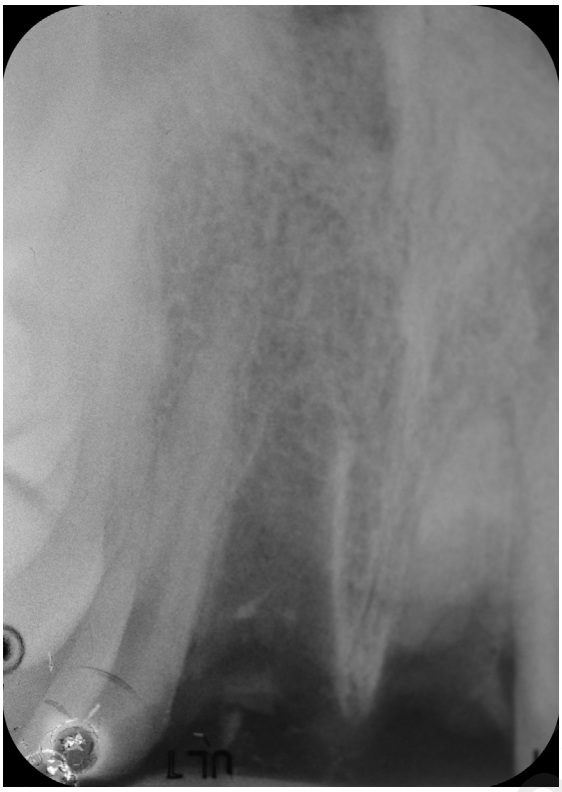

Figure 2
Preoperative periapical X-ray. Complete avulsion of teeth 1.1 e 2.1 and apical fragment of tooth 2.1 root.

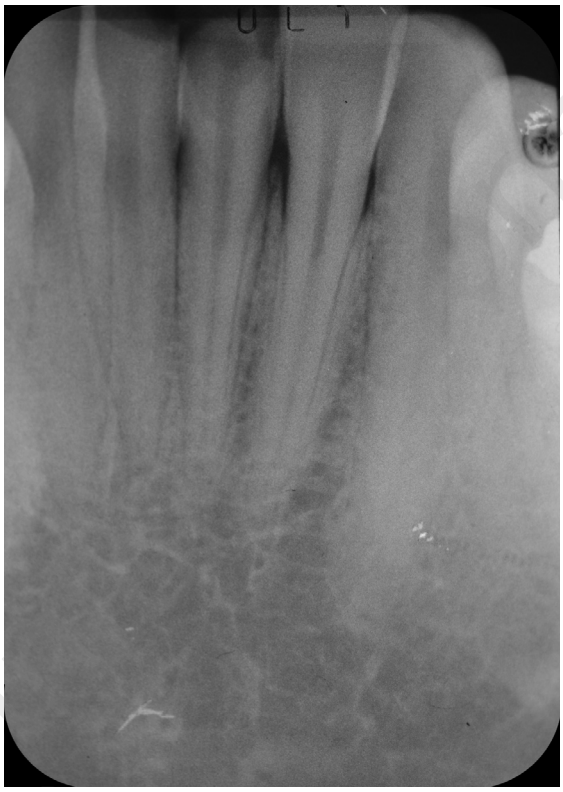

Figure 3
Periapical X-ray of inferior anterior teeth after dental trauma.

preserved in saline and were replanted in their original position. A vestibular splint was performed including all traumatized teeth and extending to sound adjacent teeth.
For the splint was used a braided metallic wire shaped to match passively of the dental arch without exerting any active force. The splint was cemented adhesively from tooth 1.3 to tooth 2.3; the surfaces of the elements was treated with 37% orthophosphoric acid for 30 seconds, rinsed thoroughly for 30 seconds and finally dried. A two steps E&R adhesive was then applied (Optibond FL, Kerr), gently rubbed with a microbrush, dried to allow the solvent to evaporate, and then cured for 20 seconds each tooth. A flowable composite Micerium EnamelPlus was used to fix the metallic wire to teeth. To ensure proper alignment, one tooth at a time received first the composite on the surface, then the metal wire and, immediately after, light cured for 20 seconds. For higher strength of splint, the metal wire was further coated with composite in the central area of the clinical crown of each tooth. All wounds were finally sutured with 3.0 Ethicon single stitches and the patient was dismissed with a prescription for a 6 days antibiotic therapy (Figure 4).
After 3 weeks from injury tooth 3.1 required endodontic therapy (27-30). After access cavity, the root canal was shaped with Mtwo instruments and obturated with warm guttapercha using the Microseal technique. After one more week, one month from traumatic injuries, also teeth 1.1 and 2.1 needed endodontic treatment. Tooth 1.1 was endodontically treated with the same techniques as tooth 3.1 (Figures 5, 6). Tooth 2.1, due to the too big diameter of the apex derived from the root fracture, was treated

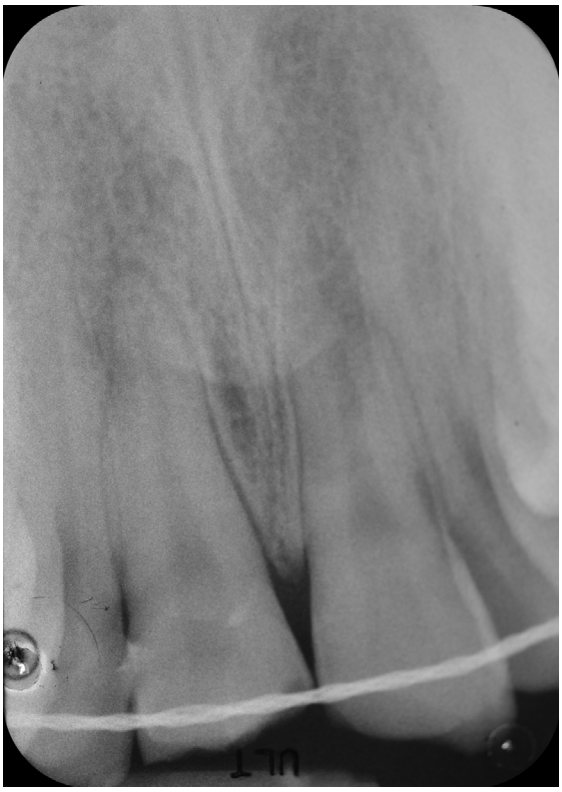

Figure 4
Splint of replanted teeth 1.1 and 2.1 after extraction of root fragment.

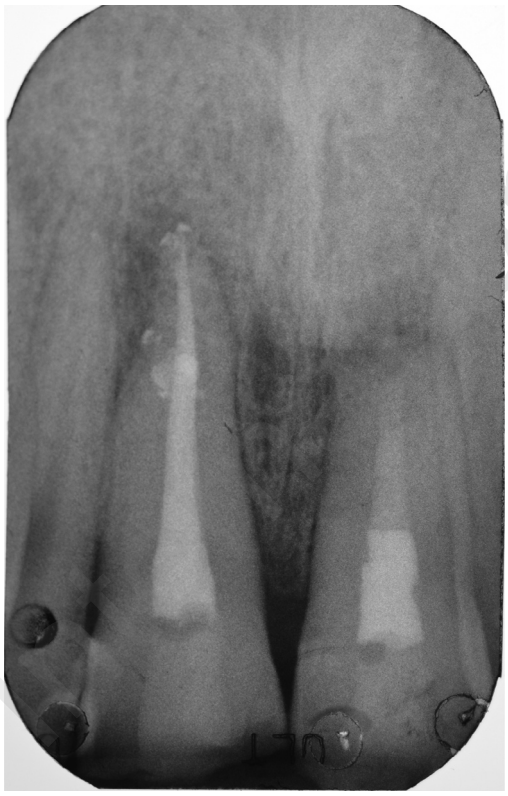

Figure 5
Endodontic treatment of tooth 1.1 and apical plug of tooth 2.1.

with an apical plug with Portland cement (31) and in a second appointment completion of the root filling with warm guttapercha over the 4 mm hardened apical plug. In a separate appointment direct composite restoration of teeth 1.1, 2.1, 3.1 and 4.1 were done (32-40).
Three months after traumatic injury also tooth 1.2 needed an endodontic treatment due to loss of vitality and acute pain.
Until December 2015 periodic follow-up with X-ray controls were made every 6 months to evaluate success of endodontic treatments and eventually treat new adverse consequences of the dental traumas (Figure 7). After that date the patient did not show at the subsequent visits and we saw him only 5 years after in February 2019. At this follow-up visit radiographic exams were taken and all treatment resulted in a success (Figures 8, 9). Both endodontic treatments and restorative procedures appeared in the parameters for a successful treatment. No signs of periapical lesions were found and esthetics resulting from restoration is good. Only concern is tooth 2.1 that after 5 years from replantation and endodontic treatment is starting to show a slight external root substitution resorption at the coronal third of the root.

Discussion

At the 5-years follow-up, tooth 1.1 does not show signs of root resorption, while the element 2.1 presents an initial reabsorption of the most coronal portion of the root (41-48). It is hypothesizable that the integrity of the socket of 1.1, compared to the root profile, has maintained a

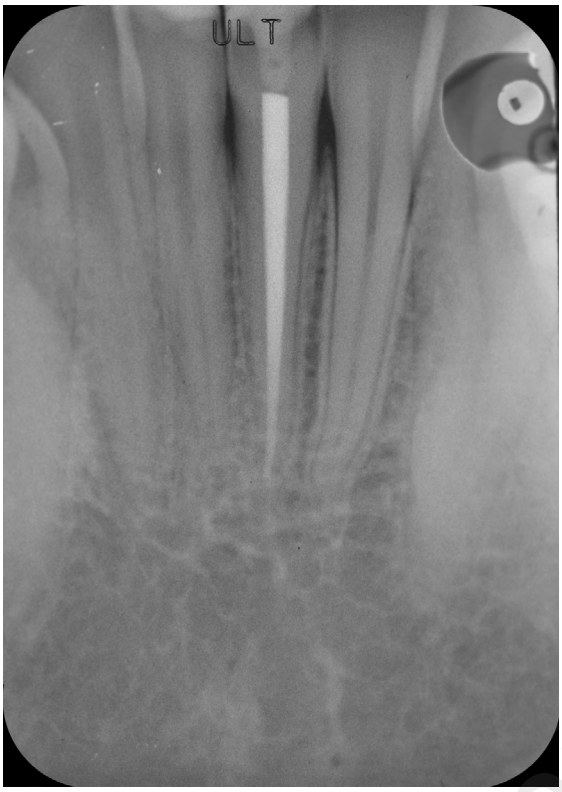

Figure 6
Endodontic treatment of tooth 3.1.

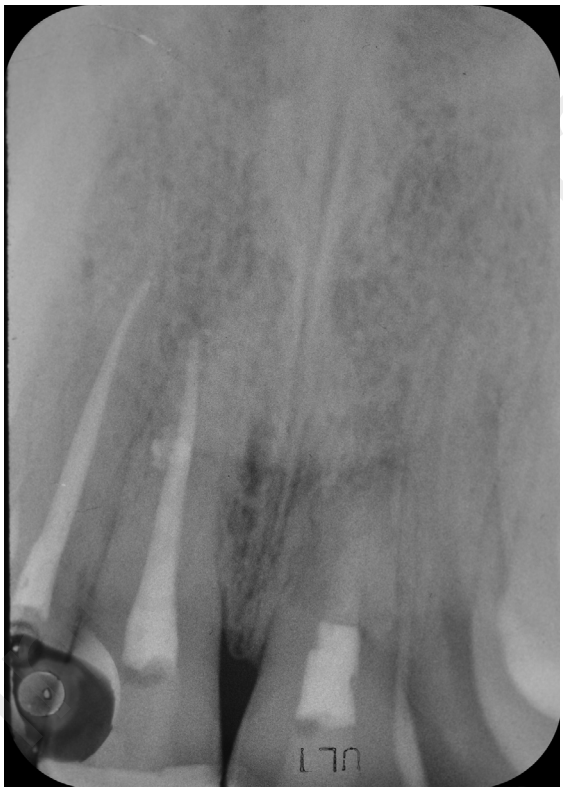

Figure 7
Follow-up after 1.5 year of teeth 1.1, 1.2, 2.1.

good stability of the tooth in the early stages that has generated a better recovery in the medium and long term. On the other hand, the socket of the element 2.1 probably suffered more from the traumatic injury; moreover the shortened dental element left greater coronal spaces that partially compromised primary stability, causing a less effective blood clot, partially compromising the periodontal healing (49-63) in the medium and long term.

Conclusions

This case report highlights the importance of a multidisciplinary training of the clinician in dealing with dental traumatology, as the complexity of the situation called for surgical, restorative and endodontic techniques.

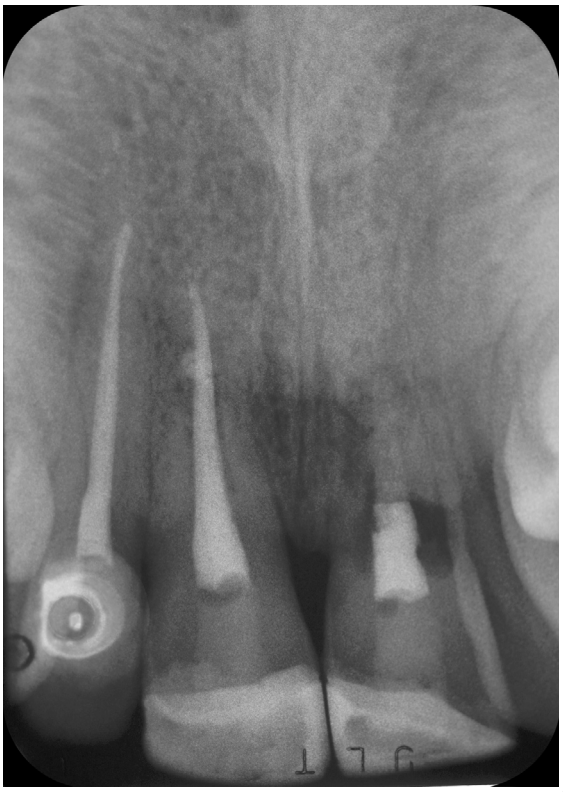

Figure 8
Follow-up after 5 years of teeth 1.1, 1.2, 2.1.

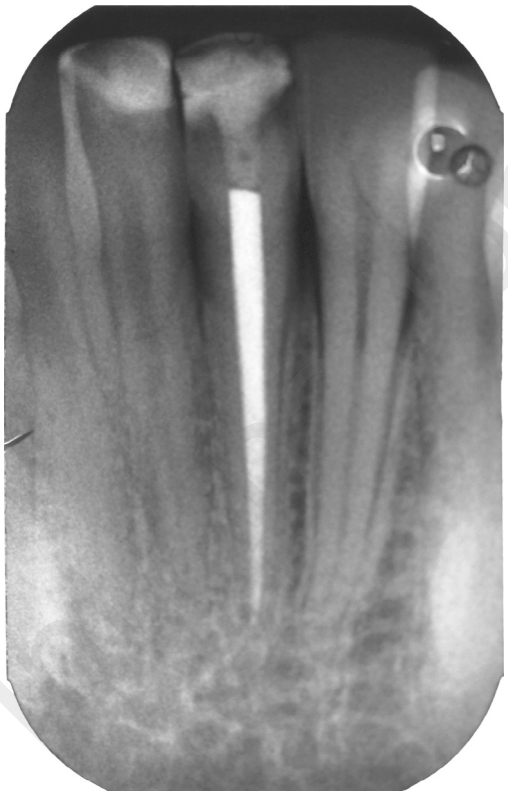

Figure 9
Follow-up after 5 years of teeth 3.1.

References

1. Andreasen JO, Andreasen FM. Avulsions. In: Andreasen JO, Andreasen FM, Andersson L, editors. Textbook and color atlas of traumatic injuries to the teeth, 4th edn. Oxford, UK: Wiley- Blackwell; 2007. p. 444-488.
2. Andersson L, Andreasen JO, Day P, Heithersay G, Trope M, Di Angelis AJ, Kenny DJ, Sigurdsson A, Bourguignon C, Flores MT, Hicks ML, Lenzi AR, Malmgren B, Moule AJ, Tsukiboshi M. International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. Pediatr Dent. 2012;39(2):412-419.
3. Flores MT, Andersson L, Andreasen JO, Bakland LK, Malmgren B, Barnett F, et al. Guidelines for the management of traumatic dental injuries.1. Fractures and Luxations of permanent teeth. Dent Traumatol. 2007; 23:66-71.
4. Flores MT, Andersson L, Andreasen JO, Bakland LK, Malmgren B, Barnett F, et al. Guidelines for the management of traumatic dental injuries.11. Avulsion of permanent teeth. Dent Traumatol. 2007;23:130-136.
5. Flores MT, Andersson L, Andreasen JO, Bakland LK, Malmgren B, Barnett F. et al. Guidelines for the management of traumatic dental injuries.111. Primary teeth. Dent Traumatol. 2007;23:196-202.
6. Hiltz J, Trope M. Vitality of human lip fibroblasts in milk, Hanks Balanced Salt Solution and Viaspan storage media. Endod Dent Traumatol. 1991;7:69-72.
7. Andreasen JO, Hjorting-Hansen E. Replantation of teeth. I. Radiographic and clinical study of 110 human teeth replanted after accidental loss. Acta Odontol Scand. 1966;24:263-286.
8. Andersson L, Bodin I, Sorensen S. Progression of root resorption following replantation of human teeth after extended extraoral storage. Endod Dent Traumatol. 1989;5:38-47.
9. Campanella V. Dental Stem Cells: current research and future applications. Eur J Paediatr Dent. 2018;19(4): 257.
10. Kling M, Cvek M, Mejáre I. Rate and predictability of pulp revascularization in therapeutically reimplanted permanent incisors. Endod Dent Traumatol. 1986;2:83-89.
11. Andersson L, Malmgren B. The problem of dentoalveolar ankylosis and subsequent replacement re-

sorption in the growing patient. Aust Endod J. 1999; 2:57-61.
12. Oikarinen K. Tooth Splinting - a review of the literature and consideration of the versatility of a wire-composite splint. Endod Dent Traumatol. 1990;6:237-250.
13. VonArx T, Fillipi A, Lussi A. Comparison of a new dental trauma splint device (TTS) with three commonly used splinting techniques. Dent Traumatol. 2001; 17:266-274.
14. Kahler B, Heithersay GS. An evidence-based appraisal of splinting luxated, avulsed and root-fractured teeth. Dent Traumatol. 2008;24:2-10. Review.
15. Berthold C, Thaler A, Petschelt A. Rigidity of commonly used dental trauma splints. Dent Traumatol. 2009;25:248-255.
16. Hinckfuss S, Messer LB. Splinting duration and periodontal outcomes for replanted avulsed teeth, a systematic review. Dent Traumatol. 2009;25:150-157.
17. Coccia CT. A clinical investigation of root resorption rates in reimplanted young permanent incisors: a five-year study. J Endod. 1980;6:413-420.
18. Ritter AL, Ritter AV, Murrah V, Sigurdsson A, Trope M. Pulp revascularization of replanted immature dog teeth after treatment with minocycline and doxycycline assessed by laser Doppler flowmetry, radiography, and histology. Dent Traumatol. 2004;20:75-84.
19. Hammarstro¨m L, Blomlo¨f L, Feiglin B, Andersson L, Lindskog S. Replantation of teeth and antibiotic treatment. Endod Dent Traumatol. 1986;2:51-57.
20. Bryson EC, Levin L, Banchs F, Trope M. Effect of minocycline on healing of replanted dog teeth after extended dry times. Dental Traumatol. 2003;19:90-95.
21. Andreasen JO, Storgaard Jensen S, Sae-Lim V. The role of antibiotics in presenting healing complications after traumatic dental injuries: a literature review. Endod Topics. 2006;14:80-92.
22. Bjorvatn K, Selvig KA, Klinge B. Effect of tetracycline and SnF2 on root resorption in replanted incisors in dogs. Scand J Dent Res. 1989;97:477-482.
23. Sae-Lim V, Wang C-Y, Choi G-W, Trope M. The effect of systemic tetracycline on resorption of dried replanted dogs' teeth. Endod Dent Traumatol. 1998;14:127-132.
24. Sae-Lim V, Wang C-Y, Trope M. Effect of systemic tetracycline and amoxicillin on inflammatory root resorption of replanted dogs' teeth. Endod Dent Traumatol. 1998;14:216-220.
25. Campanella V, Libonati A, Nardi R, Angotti V, Gallusi G, Montemurro E, D'Amario M, Marzo G. Single tooth anesthesia versus conventional anesthesia: a cross-over study. Clin Oral Investig. 2018;22(9):3205-3213.
26. Libonati A, Nardi R, Gallusi G, Angotti V, Caruso S, Coniglione F, Marzo G, Mattei A, Tecco S, Paglia L, Campanella V. Pain and anxiety associated with Computer-Controlled Local Anaesthesia: systematic review and meta-analysis of cross-over studies. Eur J Paediatr Dent. 2018;19(4):324-332.
27. Pinto A, Arcuri L, Carosi P, Nardi R, Libonati A, Ottria L, Campanella V. In vitro evaluation of the post-space depth reading with an intraoral scanner (IOS) compared to a traditional silicon impression. Oral Implantol (Rome). 2017;10(4):360-368.
28. Caruso S, Dinoi T, Marzo G, Campanella V, Giuca MR, Gatto R, Pasini M. Clinical and radiographic evaluation of biodentine versus calcium hydroxide in primary teeth pulpotomies: a retrospective study. BMC Oral Health. 2018;18(1):54.
29. Libonati A, Di Taranto V, D Agostini C, Santoro MM, Di Carlo D, Ombres D, Gallusi G, Favalli C, Marzo G, Campanella V. Comparison of coronal leakage of different root canal filling techniques: an ex vivo study. J Biol Regul Homeost Agents. 2018 Mar-Apr; 32(2):397-405.
30. Libonati A, Montemurro E, Nardi R, Campanella V. Percentage of Gutta-percha-filled Areas in Canals Obturated by 3 Different Techniques with and without the Use of Endodontic Sealer. J Endod. 2018 Mar;44(3): 506-509.
31. Cianconi L, Palopoli P, Campanella V, Mancini M. Composition and microstructure of MTA and Aureoseal Plus: XRF, EDS, XRD, and FESEM evaluation. Eur J Paediatr Dent. 2016;17(4):281-285.
32. Gallusi G, Libonati A, Campanella V. SEM-morphology in dentinogenesis imperfecta type II: microscopic anatomy and efficacy of a dentine bonding system. Eur J Paediatr Dent. 2006;7(1):9-17.
33. Libonati A, Marzo G, Klinger FG, Farini D, Gallusi G, Tecco S, Mummolo S, De Felici M, Campanella V. Embriotoxicity assays for leached components from dental restorative materials. Reprod BiolEndocrinol. 2011;9:136.
34. Ballesio I, Angotti, V, Gallusi G, Libonati A, Tecco S, Marzo G, Campanella V. Durability of adhesion between an adhesive and post-space dentin: Push-out evaluation at one and six months. Int J Adhesion and Adhesives. 2012;38:75-78.
35. Vadini M, De Angelis F, D'Amario M, Marzo G, Baldi M, D'Arcangelo C. Conservative restorations of endodontically compromised anterior teeth in paediatric patients: physical and mechanical considerations. Eur J Paediatr Dent. 2012;13(3 Suppl):263-267.
36. Tecco S, Lacarbonara M, Dinoi MT, Gallusi G, Marchetti E, Mummolo S, Campanella V, Marzo G. The retrieval of unerupted teeth in pedodontics: two case reports. J Med Case Rep. 2014;8(1):334.
37. D'Amario M, De Angelis F, Vadini M, Marchili N, Mummolo S, D'Arcangelo C. Influence of a repeated pre heating procedure on mechanical properties of three resin composites. Oper Dent. 2015 Mar-Apr; 40(2):181-189.
38. Zarow M, D'Arcangelo C, D'Amario M, Marzo G. Consrvative approach for the managment of congenital bilateral agenesis of permanent mandibular incisors: Case Report and litarture review. Eur J Paediatr Dent.

2015;16(2):154-158.
39. Frascaria M, Casinelli M, Mauro S, D'Amario M, Gatto R, Marzo G. Aesthetic rehabilitation in a young patient using a minimally invasive approach. A multidisciplinary case report. Eur J Paediatr Dent. 2016;17 (3):234-238.
40. Campanella V, Di Taranto V, Libonati A, Marzo G, Nardi R, Angotti V, Gallusi G. Indirect adhesive rehabilitation by cementation under pressure of a case of Dentinogenesis Imperfecta type II: follow-up after 13 years. Eur J Paediatr Dent. 2018;19(4):303-306.
41. Cardelli PL, Vertucci V, Balestra F, Montani M, Arcuri C. Mechanical evaluation and fem analysis of stress in fixed partial dentures zirconium-ceramic. Oral Implantol. 2014 Apr 4;6(3):55-62.
42. Germano F, Melone P, Testi D, Arcuri L, Marmiroli L, Petrone A, Arcuri C. Oral complications of head and neck radiotherapy: prevalence and management. Minerva Stomatol. 2015 Aug;64(4):189-202.
43. Di Girolamo M, Calcaterra R, Di Gianfilippo R, Arcuri C, Baggi L. Bone level changes around platform switching and platform matching implants: a systematic review with meta-analysis. Oral Implantol. 2016 Nov 13;9(1):1-10.
44. Di Girolamo M, Arullani CA, Calcaterra R, Manzi J, Arcuri C, Baggi L. Preservation of extraction socket in immediate implant placement: A clinical study. Oral Implantol. 2016 Nov 16;9(4):222-232.
45. Arcuri L, De vico G, Ottria L, Condò R, Cerroni L, Mancini M, Barlattani A. Smart fusion vs. double scan: a comparison between two data-matching protocols for a computer guided implant planning. Clin Ter. 2016 May-Jun;167(3):55-62.
46. Libonati A, Montella D, Montemurro E, Campanella V. External Cervical Resorption: a case report. Eur J Paediatr Dent. 2017;18(4):296-298.
47. Arcuri L, Contaldo M, Santoro R, Pozzi A, Lorenzi C, Barlattani A, Tettamanti L, Ottria L. Radiosurgery-assisted gingival displacement: a proof of concept technique to enhance the efficiency of intraoral digital impression. J Biol Regul Homeost Agents. 2018 Jan-Feb;32(2 Suppl. 1):197-201.
48. Lorenzi C, Arcuri L, Lio F, Dolci A, Arcuri C. Radiosurgery in dentistry: a review. Clin Ter. 2019 Jan-Feb;170(1):e48-e54.
49. Marchetti E, Mummulo S, Marzo G, Civisca A, Di Pietro C, Marinelli G. Effect of an essential-oil containing mouthrinse on the reduction of plaque and interproximal inflammation in comparison with an ethanol solution. Prev Assist Dent. 2009; 35:123-127.
50. Marchetti E, Mummolo S, Di Mattia J, Casalena F, Di Martino S, Mattei A, et al. Efficacy of essential oil mouthwash with and without alcohol: a 3-day plaque accumulation model. Trials. 2011;12:262.
51. Tecco S, Mummolo S, Marchetti E, Tetè S, Campanella V, Gatto R, Gallusi G, Tagliabue A, Marzo G. sEMG activity of masticatory, neck, and trunk muscles during the treatment of scoliosis with functional braces. A longitudinal controlled study. J Electromyogr Kinesiol. 2011 Dec; 21(6):885-892.
52. Mummolo S, Marchetti E, Giuca MR, Gallusi G, Tecco S, Gatto R, Marzo G. In-office bacteria test for a microbial monitoring during the conventional and self-ligating orthodontic treatment. Head Face Med. 2013 Feb 1;9:7.
53. Giuca MR, Pasini M, Tecco S, Giuca G, Marzo G. Levels of salivary immunoglobulins and periodontal evaluation in smoking patients. BMC Immunology. 2014;15(1):5.
54. Mummolo S, Marchetti E, Albani F, Campanella V, Pugliese F, Di Martino S, Tecco S, Marzo G. Comparison between rapid and slow palatal expansion: evaluation of selected periodontal indices. Head Face Med. 2014;10(1):30.
55. Mummolo S, Tieri M, Tecco S, Mattei A, Albani F, Giuca MR, Marzo G. Clinical evaluation of salivary indices and levels of Streptococcus Mutans and Lactobacillus in patients treated with Occlus-o-Guide. Eur J Paediatr Dent. 2014 Dec;15(4):367-370.
56. D'Ercole S, Tripodi D, Marzo G, Bernardi S, Continenza MA, Piattelli A, Iaculli F, Mummolo S. Microleakage of bacteria in different implant-abutment assemblies: an in vitro study. J Appl Biomater Funct Mater. 2015 Jul 4;13(2):e174-180.
57. Tundo GR, Sbardella D, Ciaccio C, De Pascali S, Campanella V, Cozza P, Tarantino U, Coletta M, Fanizzi FP, Marini S. Effect of cisplatin on proteasome activity. J Inorg Biochem. 2015;153:253-258.
58. Valeriani F, Protano C, Gianfranceschi G, Cozza P, Campanella V, Liguori G, Vitali M, Divizia M, Romano Spica V. Infection control in healtcare settings: perspectives for mfDNA analysis in monitoring sanitation procedures. BMC Infect Dis. 2016;16(1):394.
59. Campanella V, Syed J, Santacroce L, Saini R, Ballini A, Inchingolo F. Oral probiotics influence oral and respiratory tract infections in pediatric population: a randomized double-blinded placebo-controlled pilot study. Eur Rev Med Pharmacol Sci. 2018;22(22):8034-8041.
60. Mummolo S, Nota A, Caruso S, Quinzi V, Marchetti E, Marzo G. Salivary Markers and Microbial flora in mouth breathing late adolescents. Biomed Res Int. 2018 Mar 5;2018:8687608.
61. Mummolo S, Nota A, De Felice ME, Marcattili D, Tecco S, Marzo G. Periodontal status of buccally and palatally impacted maxillary canines after surgical-orthodontic treatment with open technique. J Oral Sci. 2018;60(4):552-556.
62. Dinoi MT, Mummolo S, Monaco A, Marchetti E, Campanella V, Marzo G. Correction to: Orthodontic treatment of the transposition of a maxillary canine and a first premolar: a case report. J Med Case Rep. 2019 Mar 4;13(1):68.
63. Libonati A, Di Taranto V, Mea A, Montemurro E, Gallusi G, Angotti V, Nardi R, Paglia L, Marzo G, Cam-

panella V. Clinical antibacterial effectiveness Healozone Technology after incomplete caries removal. Eur J Paediatr Dent. 2019 Mar;20(1):73-78.
64. Rocci A, Calcaterra R, Rocci M, Rocci C, Di Girolamo M, Baggi L. Different performance of platform switching in equicrestal position implant: an histological study. Oral Implantol (Rome). 2016 Nov 13;9(1):11-16.
65. Rocci A, Calcaterra R, Di Girolamo M, Rocci M, Rocci C, Baggi L. The influence of micro and macro-geometry in term of bone-implant interface in two implant systems: an histomorphometrical study. Oral Implantol (Rome). 2016 Jul 23;8(4):87-95.
66. Iezzi G, Iaculli F, Calcaterra R, Piattelli A, Di Girolamo M, Baggi L. Histological and Histomorphometrical Analysis on a Loaded Implant With Platform-Switching and Conical Connection: A Case Report. J Oral Implantol. 2017 Jun;43(3):180-186.
67. Calcaterra R, Di Girolamo M, Mirisola C, Baggi L. Effects of Repeated Screw Tightening on Implant Abutment Interfaces in Terms of Bacterial and Yeast Leakage in Vitro: One-Time Abutment Versus the Multiscrewing Technique. Int J Periodontics Restorative Dent. 2016 Mar-Apr;36(2):275-280.
68. Calcaterra R, Di Girolamo M, Mirisola C, Baggi L. Expression of Pattern Recognition Receptors in Epithelial Cells Around Clinically Healthy Implants and Healthy Teeth. Implant Dent. 2016 Jun;25(3):348-352.
69. Baggi L, Di Girolamo M, Mirisola C, Calcaterra R. Microbiological evaluation of bacterial and mycotic seal in implant systems with different implant-abutment interfaces and closing torque values. Implant Dent. 2013 Aug;22(4):344-350.
70. Giancotti A, Greco M, Mampieri G, Arcuri C. Palatal-implant anchorage in an adult class II patient. J Clin Orthod. 2011 Nov;45(11):627-634.
71. Carramolino-Cuéllar, E, Lauritano D, Silvestre F-J, Carinci F, Lucchese A, Silvestre-Rangil J. Salivary flow and xerostomia in patients with type 2 diabetes. Journal of Oral Pathology and Medicine. 2018;47 (5):526-530.
72. Lauritano D, Lucchese A, Gabrione F, Di Stasio D, Silvestre Rangil J, Carinci F. The effectiveness of laser-assisted surgical excision of leukoplakias and hyperkeratosis of oral mucosa: a case series in a group of patients. Int J Environ Res Public Health. 2019;16:210.
73. Andreasi Bassi M, Bedini R, Pecci R, Ioppolo P, Lauritano D, Carinci F. Mechanical Properties of Abutments: Resin-Bonded Glass Fiber-Reinforced Versus Titanium. International Journal of Prosthodontics. 2016;29(1):77-79. Published: JAN-FEB 2016.
74. Candotto V, Lauritano D, Carinci F, Bignozzi CA, Pazzi D, Cura F, Severino M, Scarano A. Silver-based chemical device as an adjunct of domestic oral hygiene: A study on periodontal patients. Materials. 2018;11(8), art. no. 1483.
75. Lauritano D, Annalisa P, Valentina C, Francesco C. Regenerative dentistry and stem cells: A multilineage differentiation as a safe and useful alternative way of harvesting and selection adipose derived mesenchymal stem cells. Current Drug Targets. 2019;19(16):1991-1997.
76. Lauritano D, Arrica M, Lucchese A, Valente M, Pannone G, Lajolo C, Ninivaggi R, Petruzzi M. Oral lichen planus clinical characteristics in Italian patients: A retrospective analysis. Head and Face Medicine. 2016; 12(1), art. no. 18.
77. Avantaggiato A, Palmieri A, Carinci F, Trapella G, Sollazzo V, Lauritano D. Effects of glucosamine and nucleotide association on fibroblast: extracellular matrix gene expression. International journal of immunopathology and pharmacology. 2014;27(4):689-693.
78. Carramolino-Cuéllar E, Lauritano D, Carinci F, Silvestre-Rangil J, Bañuls-Morant C, Silvestre FJ, Hernández-Mijares A. Salivary glucose as a metabolic control marker in patients with type 2 diabetes. Journal of Biological Regulators and Homeostatic Agents. 2017;31(2, Supplement 1):181-187.
79. Lauritano D, Avantaggiato A, Candotto V, Cura F, Gaudio RM, Martinelli M, Palmieri A. Insulin activity on dental pulp stem cell differentiation: An in vitro study. Journal of Biological Regulators and Homeostatic Agents. 2015;29(3):48-53.
80. Sabatini S, Lauritano D, Candotto V, Silvestre FJ, Nardi GM. Oral probiotics in the management of gingivitis in diabetic patients: A double blinded randomized controlled study. Journal of Biological Regulators and Homeostatic Agents. 2017;31(2, Supplement 1):197-202.
81. Lauritano D, Martinelli M, Mucchi D, Palmieri A, Lo Muzio L, Carinci F. Bacterial load of periodontal pathogens among Italian patients with chronic periodontitis: A comparative study of three different areas. Journal of Biological Regulators and Homeostatic Agents. 2016;30(2):149-154.
82. Lauritano D, Lo Muzio L, Gaudio RM, Lo Russo L, Mucchi D, Nardi GM, Scapoli L. The ecological catastrophe of oral diseases: A possible link between periodontitis and protozoa. Journal of Biological Regulators and Homeostatic Agents. 2016;30(2):143-147.
83. Lauritano D, Lo Muzio L, Gaudio RM, Lo Russo L, Mucchi D, Nardi GM, Martinelli M. Why should patients with systemic disease and tobacco smokers go to the dentist? Journal of Biological Regulators and Homeostatic Agents. 2016;30(2):135-141.
84. Carinci F, Martinelli M, Contaldo M, Santoro R, Pezzetti F, Lauritano D, Candotto V, Mucchi D, Palmieri A, Tagliabue A, Tettamanti L. Focus on periodontal disease and development of endocarditis. Journal of Biological Regulators and Homeostatic Agents. 2018;32(2):143-147.
85. Silvestre FJ, Lauritano D, Carinci F, Silvestre-Rangil J, Martinez-Herrera M, Del Olmo A. Neuroinflamma-

tion, Alzheimer's disease and periodontal disease: Is there an association between the two processes? Journal of Biological Regulators and Homeostatic Agents. 2017;31(2, Supplement 1):189-196.
86. Carinci F, Girardi A, Palmieri A, Martinelli M, Scapoli L, Avantaggiato A, Nardp GM, Lauritano D. LAB®-test 2: Microflora and periodontal disease. European Journal of Inflammation. 2012;10(1):95-98.
87. Roncati M, Lauritano D, Tagliabue A, Tettamanti L. Nonsurgical periodontal management of iatrogenic peri-implantitis: A clinical report. Journal of Biological Regulators and Homeostatic Agents. 2015;29(3):164-169.
88. Lauritano D, Cura F, Gaudio RM, Pezzetti F, Andreasi Bassi M, Carinci F. Polymerase chain reaction to evaluate the efficacy of silica dioxide colloidal solutions in the treatment of chronic periodontitis: A case control study. Journal of Biological Regulators and Homeostatic Agents. 2015;29(3):131-135.
89. Lauritano D, Bignozzi CA, Pazzi D, Palmieri A, Gaudio RM, Di Muzio M, Carinci F. Evaluation of the efficacy of a new oral gel as an adjunct to home oral hygiene in the management of chronic periodontitis. A microbiological study using PCR analysis. Journal of Biological Regulators and Homeostatic Agents. 2016;30 (2):123-128.
90. Lauritano D, Pazzi D, Iapichino A, Gaudio RM, Muzio MDI, Lo Russo L, Pezzetti F. Evaluation of the efficacy of a new oral gel containing carvacrol and thymol for home oral care in the management of chronic periodontitis using PCR analysis: A microbiological pilot study. Journal of Biological Regulators and Homeostatic Agents. 2016;30(2):129-134.
91. Lauritano D, Candotto V, Bignozzi CA, Pazzi D, Carinci F, Cura F, Tagliabue A, Tettamanti L. Zinc plus octenidine: A new formulation for treating periodontal pathogens. A single blind study. Journal of Biological Regulators and Homeostatic Agents. 2018;32(2):231-236.
92. Campanelli LC, Oliveira NTC, da Silva PSCP, Bolfarini C, Palmieri A, Cura F, Carinci F, Motheo AJ. Fatigue resistance, electrochemical corrosion and biological response of Ti-15Mo with surface modified by amorphous TiO2 nanotubes layer. J Biomed Mater Res B Appl Biomater. 2019 Jan;107(1):86-96.
93. Arcuri C, Muzzi F, Santini F, Barlattani A, Giancotti A. Five years of experience using palatal mini-implants for orthodontic anchorage. J Oral Maxillofac Surg. 2007 Dec;65(12):2492-2497.
94. Giancotti A, Greco M, Mampieri G, Arcuri C. Treatment of ectopic maxillary canines using a palatal implant for anchorage. J Clin Orthod. 2005 Oct;39(10): 607-611.
95. Concolino P, Cecchetti F, D'Autilia C, Santonocito C, Di Stasio E, Zuppi C, Arcuri C, Deli G, Giardina B, Capoluongo E, Ameglio F. Association of periodontitis with GSTM1/GSTT1-null variants-a pilot study. Clin Biochem. 2007 Sep;40(13-14):939-45. Epub 2007 Apr 27.
96. Di Vecchio S, Manzini P, Candida E, Gargari M. Froggy mouth: A new myofunctional approach to atypical swallowing. European Journal of Paediatric Dentistry. 2019;20(1):33-37.
97. Salvatori C, Barchi L, Guzzo F, Gargari M. A comparative study of antibacterial and anti-inflammatory effects of mouthrinse containing tea tree oil. ORAL and Implantology. 2017;10(1):59-70.
98. Lorè B, Gargari M, Ventucci E, Cagioli A, Nicolai G, Calabrese L. A complication following tooth extraction: Chronic suppurative osteomyelitis. ORAL and Implantology. 2013;6(2):43-47.

Correspondence to:
Virginia Di Taranto, DMD
University of Rome "Tor Vergata"
Department of Clinical Sciences and Translational Medicine
Rome, Italy
E-mail: virginia.ditaranto@gmail.com