

European Society of Endodontology position statement: Surgical extrusion, intentional replantation and tooth autotransplantation



European Society of Endodontology developed by:

G. Plotino¹, F. Abella Sans², M. S. Duggal³, N. M. Grande⁴, G. Krastl⁵, V. Nagendrababu⁶ & G. Gambarini¹

¹Department of Endodontics, "Sapienza" - University of Rome, Rome, Italy; ²Department of Endodontics, Universitat Internacional de Catalunya, Barcelona, Spain; ³Faculty of Dentistry, National University Health System, Singapore;

⁴Department of Endodontics, Catholic University of Sacred Heart, Rome, Italy; ⁵Department of Conservative Dentistry and Periodontology and Center of Dental Traumatology, University Hospital of Würzburg, Würzburg, Germany; and ⁶Department of Preventive and Restorative Dentistry, College of Dental Medicine, University of Sharjah, Sharjah, UAE

Abstract

Plotino G, Abella Sans F, Duggal MS, Grande NM, Krastl G, Nagendrababu V, Gambarini G. European Society of Endodontology position statement: Surgical extrusion, intentional replantation and tooth autotransplantation. *International Endodontic Journal*, 54, 655–659, 2021.

This European Society of Endodontology (ESE) position statement on surgical extrusion, intentional replantation and tooth autotransplantation represents the consensus of an expert committee, convened by the ESE. A narrative review (Plotino *et al.* 2020, *International Endodontic Journal*, 53, 1636–52) formed the basis for the position statement. The review provided detailed information on the

background, clinical procedures and the outcome of surgical extrusion, intentional replantation and tooth autotransplantation techniques. The aim of the current statement is to summarize the best available evidence on these clinical techniques to provide appropriate clinical guidance to undergraduate and postgraduate students, dental practitioners, clinical teachers and researchers. The current position statement will be updated by the ESE periodically to reflect new evidence as it becomes available to provide the most current treatment guidance for clinical practice.

Keywords: intentional replantation, surgical extrusion, tooth autotransplantation.

Received 27 November 2020; accepted 30 November 2020

Introduction

Teeth considered nonrestorable by conventional treatments, such as those with unmanageable endodontic disease, subgingival caries or fractures, are candidates for management by surgical extrusion, intentional

replantation or tooth autotransplantation. These related procedures have a similar approach involving the atraumatic detachment of a tooth from its alveolus. In surgical extrusion, the tooth is surgically shifted within the socket to a more favourable position so that the remaining tooth structure is more

Further additions, comments and consensus by ESE Executive Board members: Dummer PMH, Duncan HF, Franco V, Galler K, Kirkevang L-L, Whitworth J.

Correspondence: Paul M. H. Dummer, CEO of the European Society of Endodontology, Postboks 1237 Vika, 0110 Oslo, Norway (e-mail: ceo@e-s-e.eu).

coronally placed (Yiğit Özer *et al.* 2011, Das & Muthu 2013). Intentional replantation (Grossman 1966) involves the atraumatic removal of a tooth, inspection of root surfaces, extra-alveolar endodontic management/repair and repositioning in the same socket at the original level. Extra-alveolar management may also form part of the surgical extrusion procedure. Tooth autotransplantation (Natiella *et al.* 1970) involves the extraction of an unerupted or erupted tooth and its placement in an extraction or surgically prepared socket within the same person.

Clinical procedures

Pre-treatment considerations

Patient consent

The clinician must provide clear and complete information on the risks and benefits of the treatment to patients. This will allow patients to make an informed decision with regard to the treatment options proposed.

Preoperative imaging

Conventional radiographs usually provide sufficient information to confirm the anatomy and/or diagnosis to execute the treatment. Small field of view preoperative cone-beam computed tomography (CBCT) may be helpful in providing three-dimensional (3D) information about the anatomy of the tooth and surrounding structures when conventional radiographs fail to provide this information (European Society of Endodontology 2019). The practitioner should be aware of the indications stated in the ESE Position Statement on CBCT (European Society of Endodontology 2019). In tooth autotransplantation, a preoperative CBCT allows the clinician to create a 3D replica of the donor tooth (Lee *et al.* 2001) and/or a 3D-printed guiding template (Strbac *et al.* 2016, Anssari Moin *et al.* 2017).

Prophylactic regimen

A systemic antibiotic prophylaxis should only be prescribed when dictated by the medical condition of the patient. Prophylactic antibiotics are recommended for individuals with complex congenital heart defects, prosthetic cardiac valves or a history of infective endocarditis, receiving intravenous bisphosphonate treatment and after joint surgeries (first 3 months) (European Society of Endodontology 2018a). Practitioners should be aware of the indications and antibiotic choices set

out in the ESE Position Statement on antibiotics (European Society of Endodontology 2018a).

Preliminary oral hygiene

Local debridement of plaque and calculus must be performed, and surgical sites must be disinfected to maintain a clean field during the procedure (Becker 2018). Chlorhexidine (0.12% or 2%) is recommended for disinfection of the surgical site (Becker 2018).

Local anaesthesia

Standard local anaesthetic solutions and techniques are recommended to anaesthetize the target area for these procedures (St George *et al.* 2018).

Treatment

Surgical extrusion and intentional replantation

- When incising the gingival fibrous attachment, utmost care should be taken to avoid mechanical damage of the root surface and the gingival fibres.
- Surgical extrusion may be performed with or without removing the tooth from its alveolus; however, if the tooth is removed, it is always advisable to perform a visual inspection of the root surface extra-orally under magnification (Kratchman 1997, Niemczyk 2001, Choi *et al.* 2014, Jang *et al.* 2016a).
- During extra-alveolar manipulation, damage to the PDL can be reduced by holding the crown of the tooth with a wet sterile gauze or the forceps used for extraction (Kratchman 1997).
- The root surface should be kept wet using appropriate storage media (e.g. special cell culture media, Hanks balanced salt solution) during all extra-alveolar procedures (Niemczyk 2001, Lee *et al.* 2018).
- The total extra-alveolar time of manipulation should be as short as possible and never exceed 15 min, as it is a critical factor for determining the long-term prognosis of the treatment (Hupp *et al.* 1998).
- During extra-alveolar procedures, protection of the blood-filled socket with sterile gauze is useful to prevent contamination of the site by saliva (Cho *et al.* 2016).
- If necessary, root-end resection with root-end filling can be performed extra-orally without substantially increasing the extra-alveolar time (Jang *et al.* 2016a). Root-end resection (2–3 mm) and cavity preparation (3 mm) should be performed to

enhance the placement of the root-end filling (Becker 2018), further simplifying the subsequent orthograde root canal treatment if it is not possible to carry it out at an earlier stage or simultaneously with the surgical procedures (Jang *et al.* 2016a).

- If surgical extrusion or intentional replantation is performed to treat teeth with cervical resorption or a deep carious lesion, all granulation and carious tissue within the defect must be removed to avoid recurrence. For restoration, glass ionomer cements, resin-based composites or fast setting hydraulic calcium-silicate materials may be selected, depending on the morphology and the extension of the resorptive cavity (European Society of Endodontology 2018b).
- Socket curettage is only recommended when a periapical granuloma and/or extruded filling materials need to be removed (Kratchman 1997, Asgary *et al.* 2014, Cho *et al.* 2016).
- The tooth should be reinserted in the socket with digital pressure and the occlusion checked (Becker 2018).
- When extrusion of the root is needed to allow a ferrule to be prepared, rotation of the root by 180 degrees before replantation may be an option to expose the defect margin on both aspects (Krastrl *et al.* 2011).

Tooth autotransplantation

- During extraction of the tooth to be replaced, the clinician must avoid damaging the cortical plates.
- In congenitally missing teeth or after early tooth loss, the recipient site needs to be prepared surgically (Yu *et al.* 2017). The recipient site should be larger than the dimensions of the donor tooth, so that the donor tooth is not inserted into the socket with undue pressure. Implant drills with internal and external water cooling or piezoelectric inserts are recommended for this procedure.
- The donor tooth requires an orthograde root canal treatment that should be performed before the surgery (if accessible) or after the surgery to minimize the time required for extra-oral procedures that may have a negative impact on the prognosis of the tooth.
- The donor tooth should be extracted as atraumatically as possible in order to minimize injury to the gingival fibres around the neck of the tooth. Consideration should be given to placement of gauze

over the crown before application of the extraction forceps to prevent crazing of surface enamel or slippage onto the root surface.

- Extra-alveolar manipulation of the donor tooth should be limited to the root-end resection and filling in mature teeth and not exceeding 15 min. It is important to keep the tooth in appropriate storage conditions.
- As soon as possible, the donor tooth should be placed in the recipient site, leaving it free from occlusal and articulation forces (Andreassen & Kristerson 1981, Jang *et al.* 2016b).
- If the donor tooth is an immature tooth with an open apex, it usually has sufficient access to blood supply as well as stem cells to promote pulp revascularization post-transplantation and it does not require orthograde or retrograde endodontic treatment. It can be placed in its original level of eruption within the recipient site to allow it to erupt, as root formation should continue after revascularization and closure of the apex. If signs or symptoms of pulp disease occur, root canal treatment can be initiated.
- Computer-aided rapid prototyping (CARP) models (tooth replicas) and 3D-printed guiding templates fabricated from CBCT imaging show the required dimensions of the recipient site during surgery related to the actual dimensions of the donor tooth and will enable its ideal 3D repositioning (Ashkenazi *et al.* 2018). This will reduce the extra-oral time and the number of fitting attempts (Lee & Kim 2012), thus minimizing iatrogenic mechanical damage to the PDL (Anssari Moin *et al.* 2017) and complications such as root resorption and attachment loss (Chung *et al.* 2014).

Post-treatment considerations

Splinting teeth

To support periodontal healing, the splint should be passive, flexible and allow good oral hygiene (Fouad *et al.* 2020). To meet these requirements, usually thin wires no greater than 0.3–0.4 mm are bonded to the labial tooth surface (Kahler *et al.* 2016). The duration of splinting depends on the stability of the tooth after replantation and can vary from 2 weeks for most cases of intentional replantation to up to 6 weeks for cases of high mobility after surgical extrusion. In specific cases, postoperative fixation can be performed with a crossed suture suspended above the occlusal

surface with or without the use of resin-based composite to fix the suture to the tooth surface.

Occlusal check

After these procedures, the occlusion has to be adjusted to relieve occlusal contacts (Asgary *et al.* 2014, Choi *et al.* 2014, Jang *et al.* 2016b, Becker 2018). It is recommended that any developing occlusal interference should be adjusted.

Pharmacological therapy

Standard medication strategies should be applied to reduce postoperative pain (Zanjir *et al.* 2020). Systemic antibiotics have the ability to reduce infection (Hammarstrom *et al.* 1986, Andreasen *et al.* 1990) and can improve the outcome of autotransplantation, as the failure rate has been reported to be 2.5 higher in studies not using systemic antibiotics compared with those using antibiotics (Chung *et al.* 2014). Similarly, the resorption rate has been reported to be 1.4 times higher in studies not using systemic antibiotics than those using antibiotics (Chung *et al.* 2014). However, the clinician should be aware of the ESE Position Statement on antibiotics (European Society of Endodontology 2018a).

Root canal treatment

Root canal treatment should be performed within 2 weeks after the surgical procedures to prevent inflammatory root resorption (Andersson *et al.* 2012).

Restorative and orthodontic treatments

According to the aesthetics and function of the tooth, restorative treatment is usually initiated six to eight weeks after the surgical intervention. In general, transplanted and replanted or extruded teeth should not be moved orthodontically for at least six months after the procedure (Kindelan *et al.* 2008, Day *et al.* 2008).

Patient information

The risks and the possible outcomes of these procedures should be always explained clearly to the patients and/or their carers.

Conclusion

Surgical extrusion, intentional replantation and tooth autotransplantation are important treatments that can be provided within the scope of Endodontic practice. The clinician's knowledge about these

procedures, their management and possible complications are important to achieve optimal success.

Conflict of interest

The European Society of Endodontology and the authors state explicitly that there is no conflict of interests related to this ESE position statement.

References

- Andersson L, Andreasen JO, Day P *et al.* (2012) International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. *Dental Traumatology* **28**, 88–96.
- Andreasen JO, Kristerson L (1981) The effect of limited drying or removal of the periodontal ligament. *Acta Odontologica Scandinavica* **39**, 1–13.
- Andreasen JO, Paulsen HU, Yu Z, Schwartz O (1990) A long-term study of 370 autotransplanted premolars. Part III. Periodontal healing subsequent to transplantation. *The European Journal of Orthodontics* **12**, 25–37.
- Anssari Moin D, Verweij JP, Waars H, van Merkesteyn R, Wismeijer D (2017) Accuracy of computed-assisted template guided autotransplantation of teeth with custom three-dimensional designed/printed surgical tooling: a cadaveric study. *Journal of Oral and Maxillofacial Surgery* **75**, e1–7.
- Asgary S, Alim Marvasti L, Kolahdouzan A (2014) Indications and case series of intentional replantation of teeth. *Iranian Endodontic Journal* **9**, 71–8.
- Ashkenazi M, Shashua D, Kegen S, Nuni E, Duggal M, Shuster A (2018) Computerized three-dimensional design for accurate orienting and dimensioning artificial dental socket for tooth autotransplantation. *Quintessence International* **49**, 663–71.
- Becker BD (2018) Intentional replantation techniques: a critical review. *Journal of Endodontics* **44**, 14–21.
- Cho SY, Lee Y, Shin SJ *et al.* (2016) Retention and healing outcomes after intentional replantation. *Journal of Endodontics* **42**, 909–15.
- Choi YH, Bae JH, Kim YK, Kim HY, Kim SK, Cho BH (2014) Clinical outcome of intentional replantation with preoperative orthodontic extrusion: a retrospective study. *International Endodontic Journal* **47**, 1168–76.
- Chung WC, Tu YK, Lin YH, Lu HK (2014) Outcomes of autotransplanted teeth with complete root formation: a systematic review and meta-analysis. *Journal of Clinical Periodontology* **41**, 412–23.
- Das B, Muthu MS (2013) Surgical extrusion as a treatment option for crown-root fracture in permanent anterior teeth: a systematic review. *Dental Traumatology* **29**, 423–31.
- Day PF, Kindelan SA, Spencer JR, Kindelan JD, Duggal MS (2008) Dental trauma: part 2. Managing poor prognosis anterior teeth - treatment options for the subsequent space in a growing patient. *Journal of Orthodontics* **35**, 143–55.

- European Society of Endodontology (2018a) European Society of Endodontology position statement: the use of antibiotics in endodontics. *International Endodontic Journal* **51**, 20–5.
- European Society of Endodontology (2018b) European Society of Endodontology position statement: external cervical resorption. *International Endodontic Journal* **51**, 1323–6.
- European Society of Endodontology (2019) European Society of Endodontology: Use of cone beam computed tomography in Endodontics. *International Endodontic Journal* **12**, 1675–8.
- Fouad AF, Abbott PV, Tsilingaridis G et al. (2020) International Association of Dental Traumatology guidelines for the management of traumatic dental injuries: 2. Avulsion of permanent teeth. *Dental Traumatology* **36**, 331–42.
- Grossman LI (1966) Intentional replantation of teeth. *The Journal of the American Dental Association* **72**, 1111–8.
- Hammarstrom L, Blomlof L, Feiglin B, Andersson L, Lindskog S (1986) Replantation of teeth and antibiotic treatment. *Dental Traumatology* **2**, 51–7.
- Hupp JG, Mesaros SV, Aukhil I, Trope M (1998) Periodontal ligament vitality and histologic healing of teeth stored for extended periods before transplantation. *Endodontics and Dental Traumatology* **14**, 79–83.
- Jang Y, Choi YJ, Lee SJ, Roh BD, Park SH, Kim E (2016b) Prognostic factors for clinical outcomes in autotransplantation of teeth with complete root formation: survival analysis for up to 12 years. *Journal of Endodontics* **42**, 198–205.
- Jang Y, Lee SJ, Yoon TC, Roh BD, Kim E (2016a) Survival rate of teeth with a C-shaped canal after intentional replantation: a study of 41 cases for up to 11 years. *Journal of Endodontics* **42**, 1320–5.
- Kahler B, Hu JY, Marriot-Smith CS, Heithersay GS (2016) Splinting of teeth following trauma: a review and a new splinting recommendation. *Australian Dental Journal* **61** (Suppl 1), 59–73.
- Kindelan SA, Day PF, Kindelan JD, Spencer JR, Duggal MS (2008) Dental trauma: an overview of its influence on the management of orthodontic treatment. Part 1. *Journal of Orthodontics* **35**, 68–78.
- Krastl G, Filippi A, Zitzmann NU, Walter C, Weiger R (2011) Current aspects of restoring traumatically fractured teeth. *The European Journal of Esthetic Dentistry* **6**, 124–41.
- Kratchman S (1997) Intentional replantation. *Dental Clinics of North America* **41**, 603–17.
- Lee SJ, Jung IY, Lee CY, Choi SY, Kum KY (2001) Clinical application of computer-aided rapid prototyping for tooth transplantation. *Dental Traumatology* **17**, 114–9.
- Lee SJ, Kim E (2012) Minimizing the extra-oral time in autogeneus tooth transplantation: use of computer-aided rapid prototyping (CARP) as a duplicate model tooth. *Restorative Dentistry and Endodontics* **37**, 136–41.
- Lee W, Stover S, Rasoulianboroujeni M et al. (2018) The efficacy of commercial tooth storage media for maintaining the viability of human periodontal ligament fibroblasts. *International Endodontic Journal* **51**, 58–68.
- Natiella JR, Armitage JE, Greene GW (1970) The replantation and transplantation of teeth. A review. *Oral Surgery, Oral Medicine and Oral Pathology* **29**, 397–419.
- Niemczyk SP (2001) Re-inventing intentional replantation: a modification of the technique. *Practical Procedures Aesthetic Dentistry* **13**, 433–9.
- Plotino G, Abella Sans F, Duggal MS et al. (2020) Clinical procedures and outcome of surgical extrusion, intentional replantation and tooth autotransplantation – a narrative review. *International Endodontic Journal* **53**, 1636–52.
- St George G, Morgan A, Meechan J et al. (2018) Injectable local anaesthetic agents for dental anaesthesia. *Cochrane Database of Systematic Reviews* **7**, CD006487.
- Strbac GD, Schnappauf A, Giannis K, Bertl MH, Moritz A, Ulm C (2016) Guided autotransplantation of teeth: a novel method using virtually planned 3-dimensional templates. *Journal of Endodontics* **42**, 1844–50.
- Yiğit Özer S, Uysal İ, Bahşi E (2011) Surgical extrusion of a complete crown fractured tooth: a case report. *International Dental Research* **1**, 70–4.
- Yu HJ, Jia P, Lv Z, Qiu LX (2017) Autotransplantation of third molars with completely formed roots into surgically created sockets and fresh extraction sockets: a 10-year comparative study. *International Journal of Oral and Maxillofacial Surgery* **46**, 531–8.
- Zanjir M, Sgro A, Lighvan NL et al. (2020) Efficacy and safety of postoperative medications in reducing pain after nonsurgical endodontic treatment: a systematic review and network meta-analysis. *Journal of Endodontics* **46**, 1387–402.