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Immediate dentoalveolar restoration of hopeless endodontically-treated maxillary central incisor compromised with trauma in anamnesis

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Abstract

Background. Realization of immediate dentoalveolar restoration approach in the projection of maxillary frontal region considered to be one of the hardest one, taking into account role of not only long-term functional but esthetic parameters that dictate success of end result. Case report described below represents successful complex approach of using immediate dentoalveolar restoration after applied conservative treatment modalities have been failed, while also blending such with mini-invasive veneering of contralateral tooth to obtain the most acceptable esthetic outcome.

Objective. To present effectiveness of immediate dentoalveolar restoration approach in case of replacing hopeless central incisor compromised by trauma factor in anamnesis, while following the most conservative treatment plan.

Case report. Female patient 29 years of age referred to clinical dentist with the chief complaint of tooth 2.1 unesthetic appearance. Patient complained on grayish color of tooth in general and occurrence of pink staining along cervical margin on the vestibula side, which she has noticed during last several months. Considering trauma fact in anamnesis, pink discoloration, clinically visualized defect in tooth structure and CBCT-identified defect inside the tooth crown and root, assumption of traumatic cervical invasive resorption was made. Two weeks after controlled extrusion was started intracanal post got totally extruded from tooth root, while tooth itself remained at its primary position. Considering young age of the patient, relatively favorable adjacent tissue conditions and personal consent of the patient it was agreed to provide future treatment with implant placement and screw-retained implant-borne crown following immediate dentoalveolar restoration protocol of intervention. Ten weeks after primary surgical intervention secondary soft tissue augmentation was provided and new provisional crown with modified and adaptive coronal contour was manufactured. To prevent any color mismatching it was decided to cover adjacent teeth with ceramic veneer. Such approach also optimizes possibilities to obtain full harmony in form between two adjacent incisors if one of them is restored by implant-borne crown.

Conclusion. The immediate dentoalveolar restoration technique epitomizes a patient-centered therapeutic approach, wherein the dental practitioner is required to execute the atraumatic extraction of the pathological tooth, subsequently place a dental implant, augment both hard and soft tissues in the peri-implant area, and install a provisional restoration, thereby achieving a predictable functional and aesthetic result within a singular visit. Further interventions, such as soft tissue grafting or the veneering of adjacent natural teeth, may be conducted subsequently to enhance the aesthetic appearance of the smile, particularly when immediate dentoalveolar restoration is performed on the anterior maxillary dentition. Given the intricate nature of the procedures involved in immediate dentoalveolar restoration, it is imperative that these interventions be carried out by a highly skilled dentist to ensure the attainment of the most reliable outcomes.

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Introduction

Immediate dentoalveolar restoration represents a valuable option of rehabilitation for cases of catastrophic destruction of previously endodontic-treated teeth, which initially had compromised prognosis [1, 2, 3]. Even though endodontic treatment itself with or without further post-and-core restoration provides significant possibilities regarding saving problematic teeth, functional and biological prognosis in many cases depends on the origin of primary issues, which have caused the need in dental intervention in general [4, 5]. Dental trauma has been widely recognized as one of major risk factors regarding development of external cervical resorption of

maxillary frontal teeth, while it also should be highlighted that trauma itself was established as only factor with significantly evidenced impact during comparison of patients groups with and without signs of external cervical resorption [6]. Moreover, tooth traumatic injury causes development of cracks and fractures of different extension within tooth structure, some of which may be not clinically manifested during primary urgent treatment appointment, but become evident later during well-planned complex intervention, or negative effect of which may be observed later during post-treatment monitoring [7]. Combined effect of internal trauma-associated cracks and external root resorption put tooth in highly compromised situation which at some time may end up with final non-restorable tooth fracture. Such kind of complication may be effectively addressed with immediate dentoalveolar restoration approach (IDR) [1, 2, 3].

Essence of IDR technique includes complex one-visit manipulation during which clinician should remove problematic tooth atraumatically, place dental implant, augment hard and soft tissue within peri-implant region and install provisional restoration [1, 2, 3]. Valuable advantages of IDR approach within clinical practice include shortened treatment time, obtainment of esthetically-acceptable restoration in one visit, minimization of further bone resorption risk, possibility to enhance contour of surrounding soft tissues and retention of its improved profile [3]. Even though IDR approach is technically complicated and changes within site morphology may not always be addressed with predictable pattern, such limitations are overweighted by the obvious clinical advantages. Before starting the IDR rehabilitation clinician should thoroughly diagnose initial clinical conditions and objectively assess if such may be corrected by the one-visit technique. Deficiency of bone volume beyond the projection of root apex or too extensive gingival recession may limit possibilities to provide predictable rehabilitation with IDR, and for those cases two-stage approach should be implemented by combining procedure of dental implant placement and peri-implant region hard and soft tissue grafting in several visits [3, 8].

Realization of IDR approach in the projection of maxillary frontal region considered to be one of the hardest one, taking into account role of not only functional but esthetic parameters that dictate success of end result. Buccal wall of alveolar socket in the projection of frontal maxillary region characterized with minimal thickness and usually contains defects of various configuration after dental trauma [3, 8, 9]. To overcome this issue while providing IDR-driven treatment plan, dental implant placement is usually oriented more to the palatal aspect. Such biologically driven three-dimensional placement of dental implant usually associated with gap between implant surface and buccal bone which may be filled with bone graft, and outline of gingival profile may receive corresponding soft tissue augmentation to compensate present apical gingival margin migration [3, 8, 9, 10].

Case report described below represents successful complex approach of using IDR technique after applied conservative treatment modalities have been failed, while also blending such with mini-invasive veneering of adjacent tooth to obtain the most acceptable esthetic outcome.

Objective

To present effectiveness of immediate dentoalveolar restoration approach in case of replacing hopeless central incisor compromised by trauma factor in anamnesis, while following the most conservative treatment plan.

Clinical case presentation

Female patient 29 years of age referred to clinical dentist with the chief complaint of tooth 2.1 unesthetic appearance. Patient complained on grayish color of tooth in general and occurrence of pink staining along cervical margin on the vestibula side, which she has noticed during last several months (Fig. 1).

She revealed that present tooth was traumatized a year ago and undergone endodontic treatment right after the trauma during her living abroad. Present clinical examination revealed the signs of horizontal and vertical infractions, while tooth structure defect and pink discoloration were also noticed on the palatal side of tooth (Fig. 2).

Figure 1. Primary appearance of problematic tooth

Figure 2. Signs of horizontal and vertical infractions, while tooth structure defect and pink discoloration were also noticed on the palatal side of tooth

Cone-beamed computed tomography (CBCT) disclosed the cervical defect present on the mesial side of tooth, while also the presence of intracanal post. Considering trauma fact in anamnesis, pink discoloration, clinically visualized defect in tooth structure and CBCT-identified defect inside the tooth crown, assumption of post-traumatic resorptive lesion was made (Fig. 3)

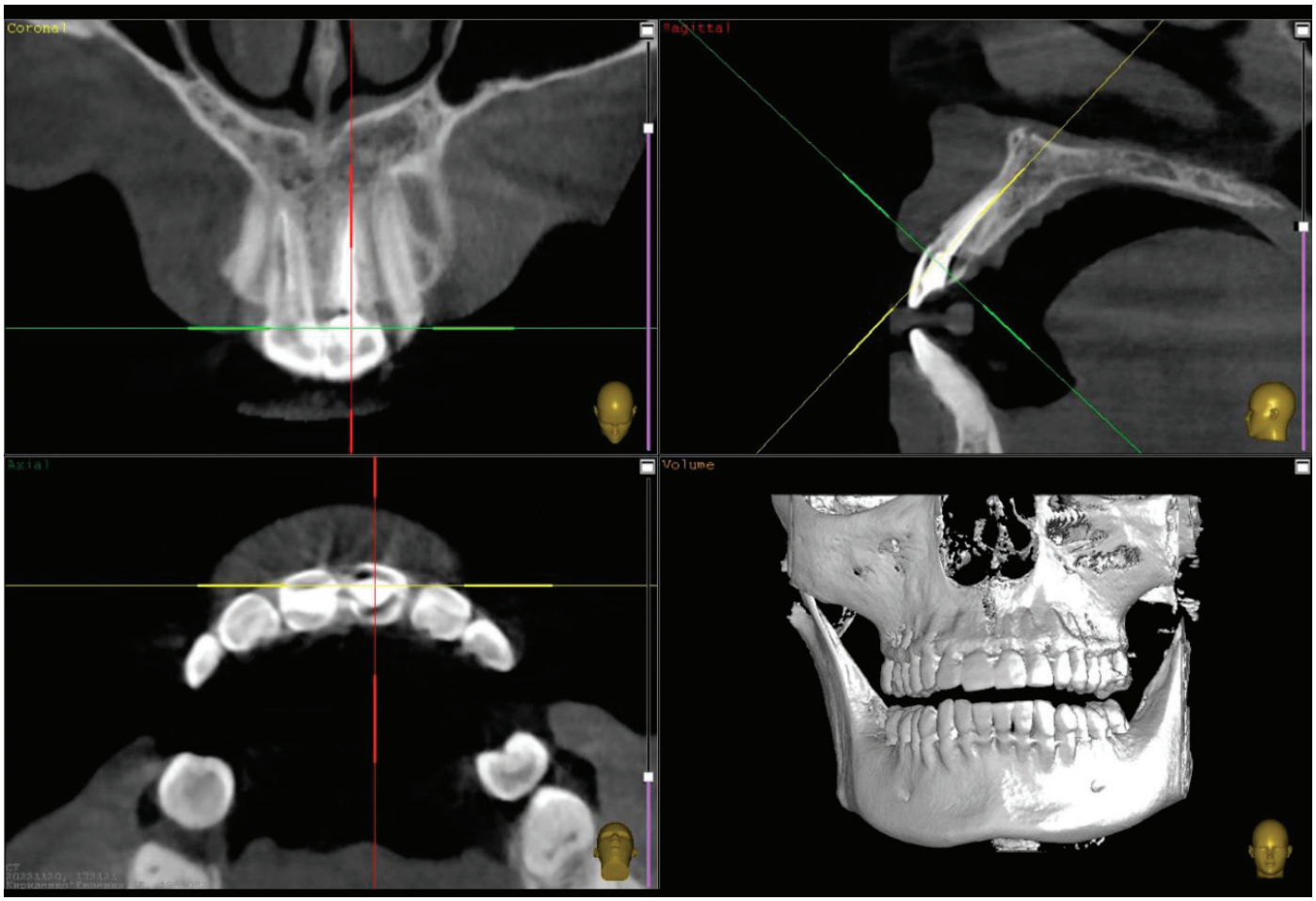

Figure 3. CBCT scan of problematic tooth with visualized cervical defect

To objectively evaluate restorability of present tooth even with verified signs of resorption attempt was made to provide its controlled partial extrusion, which may help to assess extent of resorption and its level in regard to crown-root transition. Tooth extrusion approach was held following principles of Neumeyer et al. [11, 12, 13]: two composite buttons were adhesively fixed on the vestibular and palatal sides of tooth, and elasto-force transparent plastic chains were connected to these buttons on one end, while another end of chains were bent over fiberglass pin fixed adhesively in horizontal positions on two adjacent teeth (Fig. 4).

Two weeks after controlled extrusion was started intracanal post got totally extruded from tooth root, while tooth itself remained at its primary position. Extrusion of intracanal post revealed the volume of crown destruction and critical compromised restorability potential of present tooth (Fig. 5).

Figure 4. Controlled partial extrusion of problematic tooth. Intraoral pictures: a – vestibular view, b - oral view

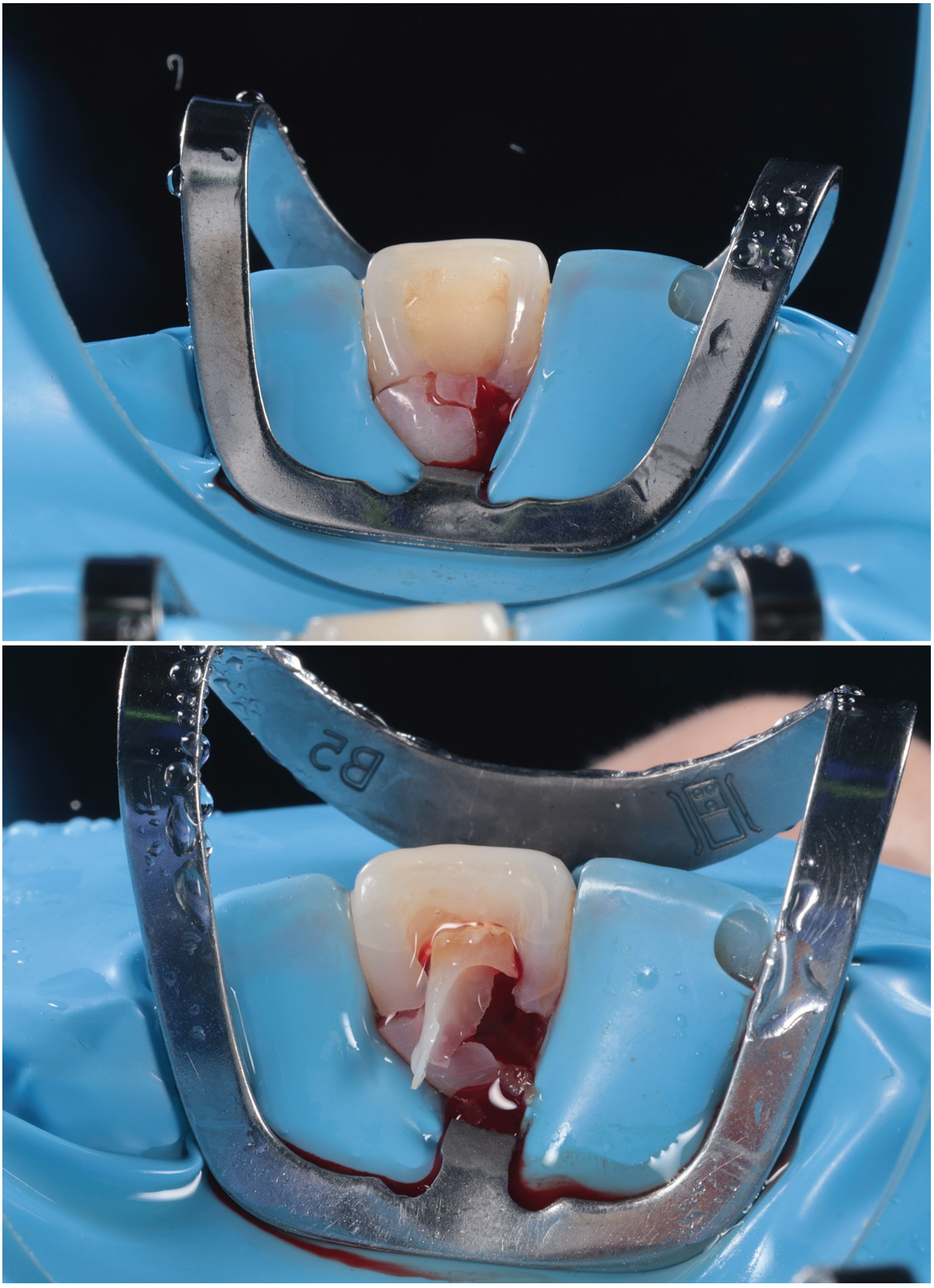

Figure 5. Extrusion of intracanal post, while tooth was retained at it's place revealing the volume of crown destruction

Patient was proposed to extract present tooth and restore dentition defect with the crown placed over dental implant as the first option of treatment, while options with fixed bridge-type construction, adhesive denture and partial removable denture were also discussed. Considering young age of the patient, relatively favorable adjacent tissue conditions and personal consent of the patient it was agreed to provide future treatment with implant placement and screw-retained implant-borne crown following immediate dentoalveolar restoration protocol of intervention.

Tooth extraction was held atraumatically, and vestibular bone fenestration was visualized within the alveolus socket, while also bone level loss was noted at the mesial bone peak. Osteotomy procedure was held though surgical implant guide manufactured on the basis of coupled CBCT and intraoral scanning data (Fig. 6-7).

Figure 6. Intraoral view of atraumatic tooth extraction

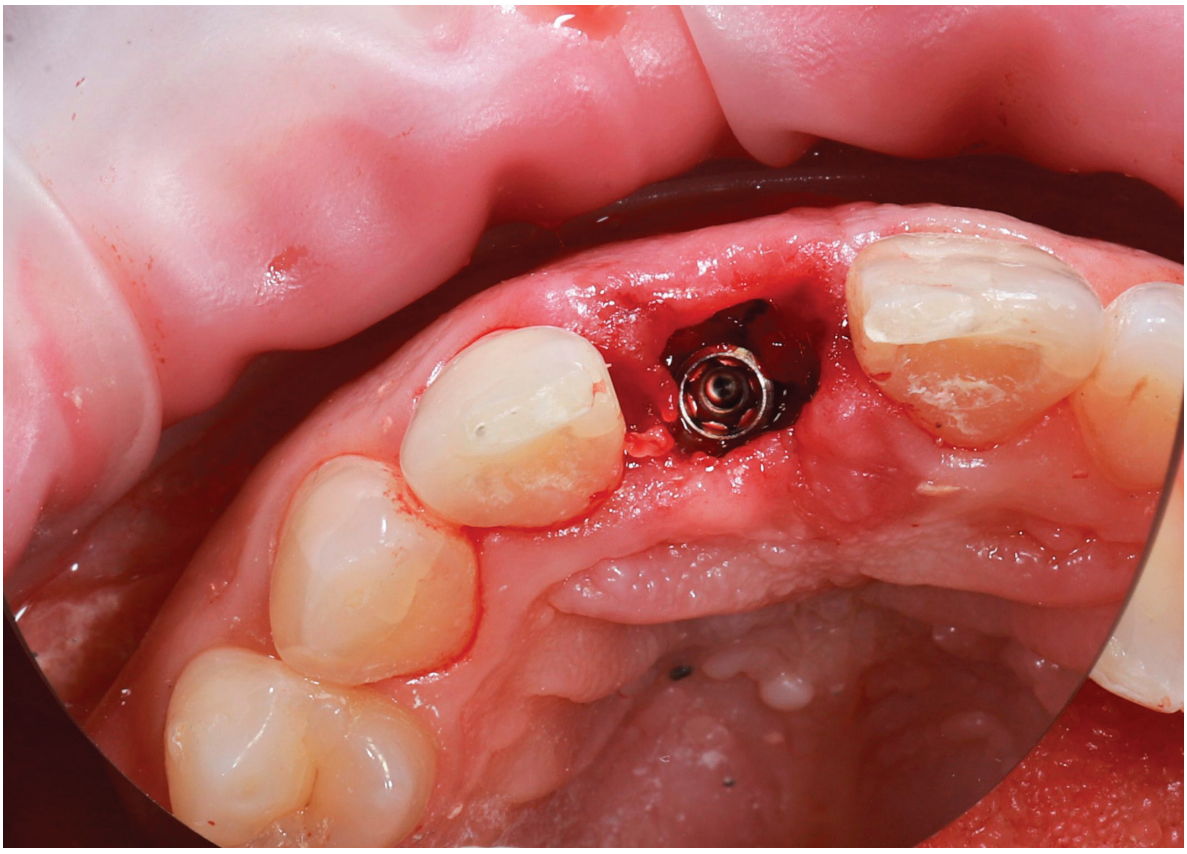

Figure 7. Intraoral view of Implant placement within the bone socket

Bone graft was obtained from maxillary tuberosity area, and such was positioned between intraosseous screw and vestibular socket bone to secure implant position within the socket with adequate level of stability. Connective tissue graft was gathered from maxillary tuberosity region and from the palate region to restore desirable soft tissue volume around installed dental implant and support medial papilla to prevent its collapse in the future (Fig. 8).

After surgical procedure was finished provisional PMMA crown was fixed over dental implant on the provisional abutment. Soft tissue was secured with coronally directed sutures. Position of abutment was checked with the periapical X-ray (Fig. 9 - 10).

Figure 8. Intraoral view of procedure of soft tissue grafting

Figure 9. Intraoral view of procedure: a - placement of the first provisional implant crown, b - fixation of the first provisional implant crown

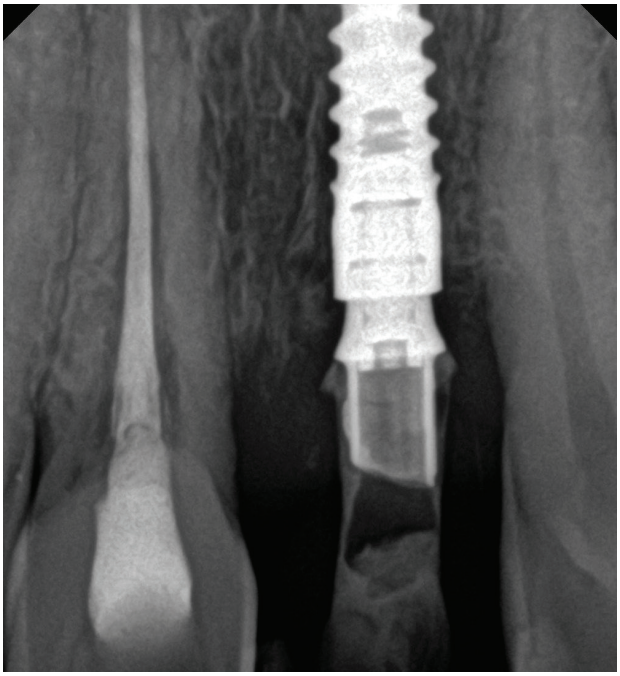

Figure 10. Intraoral X-ray after provisional implant crown placement

Two weeks after the implant placement sutures were removed and tissue were left without any further interventions for next 6 weeks to undergone physiological maturation (Fig. 11).

Volume and texture of peri-implant soft tissues six weeks after implant placement was esthetically pleasant and functionally satisfactory (Fig. 12).

10 weeks after primary surgical intervention secondary soft tissue augmentation was provided and new provisional crown with modified and adaptive contour was manufactured.

To prevent any color mismatch it was decided to cover adjacent tooth (tooth 1.1) with ceramic veneer. Such approach also optimizes possibilities to obtain full harmony in form between two adjacent incisors if one of them is restored by implant-borne crown (Fig. 13).

Final prosthetic restorations were obtained through the digital protocol with the use of intraoral scanning procedure.

Visually pleasant smile appearance and healthy conditions of surrounding gingiva supported by ideal correspondence in pink and white esthetics was observed at the end of the treatment (Fig. 14).

Discussion

Data obtained from recent study revealed that nearly 30% of all endodontically treated teeth further were replaced with dental implants. Endodontic treatment failure was associated only with 2.4% of tooth-implant replacements, while defective restoration, and fracture of different localization noticed among endodontically-treated were responsible for nearly 50% of extraction with subsequent

Figure 11. Intraoral view of appearance: a - right before sutures removal, b - right after sutures removal

Figure 12. Intraoral view of appearance six weeks after surgical intervention

Figure 13. Color selection before intraoral scanning procedure after adjacent tooth was prepared for veneer

Figure 14. Visually pleasant smile appearance 2 years after the end of treatment

intraosseous fixture installation [14]. Comparison of endodontic treatment and implant placement demonstrated that both these treatment modalities are acceptable by the patients, but comparative predictability and preference of one over another remains unclear [15]. In cases of endodontically diseased tooth endodontic treatment seems to be more cost-effective procedure than single implant placement, but only if tooth structure is not parallelly compromised with other structurally aggravating conditions [16]. Present case report demonstrated that teeth compromised with trauma accident in anamnesis characterized with risks in regard to further predictive functioning with post-and-core restoration.

Primary intention in present case report was to provide the most predictable restoration of problematic tooth taking into account patients personal request regarding correction of its esthetic appearance. Taking into account the fact of previous trauma and signs of cracks and resorption visualized clinically the very first attempt was made to provide orthodontic extrusion of teeth which potentially may improve its further restorability potential [11, 12]. Such manipulation was provided following Neumeyer's concept, which may be used not only for the restoration over residual root segments, but also as bone preservation technique in cases when restorative potential of tooth is fully compromised [11]. Previously Bosly et al. presented case series where clinical applicability of orthodontic extrusion approach was evidenced for optimization of extensively destroyed teeth treatment, and authors recommended use of such approach for the esthetic regions of maxillary arch [17]. In present case report provided orthodontic extrusion demonstrated insolvency of tooth structure and post's restoration, thus directing treatment plan to the immediate dentoalveolar restoration option and single implant tooth replacement.

IDR incorporates immediate implant placement and immediate loading of intraosseous screw, which have shown to be reliable option for single maxillary anterior restorations. Systematic review of Wittneben et al. resumed that survival rates of immediately loaded dental implant and immediately loaded single restorations are in the range of 93.3-97.4% and 89.6-97.4% respectively after 5 years of functioning [18]. Another systematic review organized by Hamilton et al. revealed that several criteria should be followed to provide predictable immediate implant placement and immediate loading of such with low risk of complications [19]. Low risk profile included patients with healthy somatic status, absence of recession, thick gingival phenotype, sufficient bone volume for the primary stability achievement, more than 1 mm of facial bone, sufficient bone volume for the realization of flapless approach, position of alveolar socket within the bone envelope, absence of endodontic-related infection, healthy periodontal status, minimally-invasive tooth extraction procedure, sufficient primary stability, gap between implant surface and buccal bone more than 2 mm, exclusion of any direct occlusal contacts, absence of occlusal parafunction, and up to 45 Ncm for the primary screw stability [19]. Such parameters were interpreted by Cosyn J. and Blanco J. as prerequisites to consider immediate implant placement and immediate implant loading as valuable treatment option and preferable one compared to early implant placement and delayed implant placement [20]. Most of above-mentioned conditions were noticed in present case report at the before treatment stage, which directed clinician to choose IDR as the most suitable option for discussed clinical situation.

Due to the systematic review of Bakkali et al. such elements of immediate dentoalveloar restoration as augmentation with connective tissue graft and bone graft mainly responsible for tissue preservation effect around immediately installed intraosseous screw [21]. Such procedures as palatal implant positioning and flapless approach did not significantly impact tissue preservation target followed during immediate dentoalveloar restoration [21]. From the other point of view incorrect implant positions during IDR may compromise the cumulative results both at the early and prolonged stages of monitoring, which is why guided implant placement is advisable in cases when anatomical conditions limit possibility of its predictable targeted sinking. Currently usage of digital dental technologies significantly optimizes the workflow of immediate dentoalveolar restoration, since implant placement positions may be strictly controlled by fabricated guide, and restoration on the individualized abutment may be manufactured in the faster way with computer-aided manufacturing technologies using data captured by intraoral scanner and rapid prototyping [22]. It may be also highlighted that incidence of the implant failure among fixtures place by free-hand approach is three times higher compared to implant placed following guided surgery (6.42% vs. 2.25%) [23]. Nevertheless, considering complexity in provided manipulations within IDR approach should be provided by experienced operator to obtain the most predictable results.

In present case report gap formed between dental implant and buccal bone of alveolar socket was filled with autologous particulate graft, because initial fenestration of buccal wall may be classified as minor, while in cases of severe bone defect augmentation may be provided with cortical-medullary bone blocks. Considering the fact that grafting of alveolar socket support preservation of horizontal bone parameters, such procedure may be interpreted as obligatory during immediate dentoalveloar restoration.

Even though number of studies reported of using specifically autologous connective tissue graft within immediate dentoalveloar restorations concept, other approaches of soft tissue grafting also seem to be applicable [19, 20, 21]. Acceptable effectiveness of using allogeneic and xenogeneic substitutes arguments their potential as alternatives to conventional connective tissue graft, since difference of effects between them and CTG seems not always to be significant, or at least not clinically expressed under peculiar conditions [24]. Systematic review of Galve-Huertas et al. also approved possibility to use acellular dermal matrix as viable option for optimization of gingival thickness and width of keratinized mucosa in cases of immediate implant placement. In present case report connective tissue graft was gathered from maxillary tuberosity region and from the palate region to restore desirable soft tissue volume around installed dental implant and support medial papilla to prevent its collapse in the future [25].

Case series of da Rosa et al. with 58 months follow up demonstrated retention of soft tissue dimensions, no recession development and slight gain in mesial and distal papillary height after single tooth replacement due to the immediate dentoalveolar restoration [2]. Several modifications of original IDR concept have been proposed. In cases which potentially may lack of primary implant stability bone preparation with osseodensification may be provided, triple graft approach may be applicable during the need of significant socket reconstruction [8, 9, 10, 26]. In present case report additional soft tissue augmentation was provided 10 weeks after primary surgical intervention with maximum integration of new provisional crown contours with modified and adaptive contour was manufactured

Provisional restoration provided over placed implant support surrounding bone tissue and helps to achieve ideal gingival contour in future. Provisionalization of immediately place implant minimize the risk of midfacial soft tissue apical migration, even though systematic review of Pitman et al. has not revealed significant role of provisional crowns in cases of immediate implant placement on changes of mesial and distal papilla, marginal bone level or probing depth [27]. However, esthetic results were found to be more favorable specifically due to the immediate provisionalization compared to the situations, where such was not used [28, 29].

Considering obtained results and available evidence-based data it may be resumed that immediate dentoalveolar restoration seems to be a valuable option of treatment for the situation with hopeless maxillary central incisor compromised with previous trauma in anamnesis, if corresponding clinical conditions are sufficient for implant placement and simultaneous soft and hard tissue augmentation.

Conclusion

Immediate dentoalveolar restoration approach represents one of the patient-centered treatment modalities, in which

dental clinician in one-visit should remove problematic tooth atraumatically, place dental implant, augment hard and soft tissue within peri-implant region and install provisional restoration, obtaining predictive functional and esthetic outcome. Additional manipulations, such as soft tissue grafting or making veneer for adjacent natural tooth, may be provided further to enhance smile appearance, if IDR approach implemented for the frontal maxillary teeth. Present case report demonstrated applicability of IDR approach in case of hopeless endodontically-treated tooth compromised with trauma and subsequent resorption lesion. Considering complexity in provided manipulations within IDR approach should be provided by experienced operator to obtain the most predictable results.

Ethical aspects

Authors confirm that they have followed all relevant ethical norms and requirements during the treatment described within present case report and preparation of present manuscript. Authors obtained full patient's agreement regarding publication of following case report, and such was approved by corresponding consent form signed by the patient personally. No information in present case report may disclose any personal data about the patient, which further may be used for patient's personal identification. Any information related to patient's identity disclosure was either deleted or anonymized within present case report.

Authors confirm that they have followed CARE guidelines while preparing present case report with intention for further publication.

Conflict of Interest

Author does not have any potential conflict of interests that may influence the decision to publish this article.

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Негайна дентоальвеолярна реставрація безнадійного раніше лікованого верхнього центрального різця з травматичним пошкодженням в анамнезі. Клінічний випадок

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A – розробка концепції та дизайну дослідження, B – збір та або систематизація даних дослідження, C – аналіз та тлумачення даних дослідження, D – написання публікації, E – критичне доопрацювання тексту публікації, F- остаточне затвердження.

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Ключові слова:
негайне навантаження дентальних імплантатів, зубо-щелепна травма, інвазивна пришийкова резорбція, атравматичне видалення зуба.

Анотація

Вступ. Реалізація підходу негайної дентоальвеолярної реставрації у фронтальному відділі верхньої щелепи вважається одним із найскладніших завдань, з огляду на необхідність досягнення не лише довгострокових функціональних, але й високих естетичних параметрів, що визначають успіх кінцевого результату. Представлений нижче клінічний випадок ілюструє успішне комплексне застосування негайної дентоальвеолярної реставрації після невдалих консервативних методів лікування, поєднане з міні інвазивним ортопедичним рішенням фіксації вініра на контрлатеральний зуб для досягнення оптимального естетичного результату.

Мета. Продемонструвати ефективність підходу негайної дентоальвеолярної реставрації у випадку заміни безнадійного центрального різця, скомпрометованого травмою в анамнезі, при дотриманні максимально консервативного плану лікування.

Клінічний випадок. Пацієнтка, 29 років, звернулася зі скаргою на неестетичний вигляд зуба 2.1. Хвору непокоїло загальне сірувате забарвлення зуба та поява рожевого відтінку в ділянці шийки зуба на вестибулярній поверхні, що було помічено протягом останніх кількох місяців. З огляду на анамнез травми, рожеву дисколорацію, клінічно візуалізований дефект твердих тканин та виявлений за допомогою КЛКТ внутрішньокоронковий дефекті дефект кореня, було зроблено припущення про травматичну цервікальну інвазивну резорбцію твердих тканин зуба. Через два тижні після початку контрольованої екструзії внутрішньоканальний штифт повністю екструдувався з кореня, тоді як сам зуб залишився на первинній позиції. Зважаючи на молодий вік пацієнтки, відносно сприятливий стан прилеглих тканин і її інформовану згоду, було прийнято рішення провести імплантацію та гвинтову фіксацію коронки за протоколом негайної імплантації та дентоальвеолярної реставрації. Через десять тижнів після первинного хірургічного втручання було виконано додаткову аугментацію м'яких тканин та виготовлено нову тимчасову коронку з модифікованим та адаптованим контуром. З метою уникнення відмінності у кольорі вирішено провести реставрацію контрлатерального зуба керамічним вініром. Такий підхід також забезпечує гармонійність форми обох центральних різців у випадку, коли один із них відновлений за допомогою імплантат-опорної коронки.

Висновки. Техніка негайної дентоальвеолярної реставрації уособлює пацієнт-орієнтований терапевтичний підхід, що передбачає атравматичне видалення ураженого зуба, негайне встановлення дентального імплантата, аугментацію твердих і м'яких тканин у періімплантатній ділянці та фіксацію тимчасової коронки, що дозволяє досягти прогнозованого функціонального й естетичного результату в межах одного візиту. Подальші втручання, такі як трансплантація м'яких тканин або реставрація суміжних природних зубів, можуть виконуватися для підвищення естетики посмішки, особливо у випадках проведення негайної дентоальвеолярної реставрації у фронтальній ділянці верхньої щелепи. Враховуючи високу складність методики, проведення таких втручань потребує високого рівня професійної підготовки лікаря для забезпечення максимально надійних результатів.

Заява про конфлікт інтересів
Цим автор підтверджує відсутність зв'язку з будь-якою організацією чи компанією, яка може мати будь-який фінансовий або нефінансовий інтерес до матеріалів дослідження, розглянутих в цій статті.

Заява про фінансування
Не було отримано жодного фінансування для допомоги в підготовці та проведенні цього дослідження, а також для написання цієї статті.

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