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Trauma to an implant-supported crown that was saved by the fixation screw: a case report

CASE REPORT

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Abstract – A traumatic impact to an implant-supported crown might damage the implant, restoration and peri-implant tissues. Ideally, only a small prosthetic retreatment is needed for restoration, as complicated prosthetic retreatments or surgical retreatments in particular, could be very inconvenient for the patient. However, there is a deficiency in literature on how the implant, restoration and surrounding tissues generally react to impact forces. This report demonstrates a case of trauma to an implant-supported crown in the maxillary anterior zone resulting in a displacement of the implant crown. After careful examination and follow-up, it appeared that only the fixation screw was damaged, whereas the implant, restoration and peri-implant tissues remained unharmed. Thanks to the protective qualities of the implant system, an easy prosthetic retreatment could restore the implant-supported crown and a surgical retreatment was prevented.

It is known that a missing anterior tooth can be successfully replaced with an implant-supported crown (1–3). However, after implant therapy is completed, several complications might occur (4, 5). These vary from peri-implant soft tissue lesions (viz. peri-implant mucositis, soft-tissue dehiscence, fistula) and abnormal marginal peri-implant bone loss (peri-implantitis), to more technical-related complications as implant fracture and fracture or loosening of the abutment, fixation screw or crown. Overload by occlusal forces is one of the factors that may induce these complications (6–8). Besides this overload, a relatively rare factor is an acute excessive load caused by a dental trauma. There is a deficiency in literature concerning the consequences of these suddenly high forces to the implant, restoration and surrounding tissues. To date, only three case reports have been published that present the consequences of a trauma to implant-supported single crowns (9–11). In two cases, the trauma resulted in damaged implant crowns and a bent fixation screw, but the implants sustained no damage (9, 10). In one case, however, the implant gave way resulting in a palatal movement of the implant within the bone, possibly in combination with a fracture of the alveolar process (11). Because the implant remained osseointegrated, it was restored with a new implant crown.

This report is aimed to further demonstrate the consequences of a trauma to an anterior implant-supported crown and the subsequent therapeutic approach that was performed.

Case report

An 18-year-old man was referred to the Department of Oral and Maxillofacial Surgery (University Medical Center Groningen, University of Groningen, Groningen, the Netherlands) for replacement of a right central incisor with an implant-supported crown. Six years ago this tooth had been avulsed in a bicycle accident and was subsequently replanted. Because of severe root resorption and a persistent fistula, the tooth could not longer be saved. After extraction, an augmentation procedure was performed with an autogenous retromolar bone graft, Bio-Oss (Geistlich Pharma AG, Wolhusen, Switzerland) and Bio-Gide (Geistlich Pharma AG) to reconstruct the alveolar process. Four months thereafter, a 16-mm Replace Select Tapered implant (Nobel Biocare AB, Göteborg, Sweden) was placed according to a two-staged procedure. After the osseointegration period, the implant was restored with a one-piece screw-retained all-ceramic crown (NobelProcera, Nobel Biocare AB).

Seven months later (14 months after implant placement), the patient consulted our department following an accident 2 days previously in a swimming pool in which his knee stroke his anterior dentition. He had no pain and only complained about a disrupted occlusion because of displacement of the implant crown. There were no extra-oral injuries. An intra-oral inspection showed that the implant crown was displaced to the palatal, causing a premature contact (Fig. 1). The

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Fig. 1. Implant-supported crown, region 11; palatal displaced after trauma.

implant crown was neither mobile nor damaged. A slight swelling and redness of the facial peri-implant mucosa was noted. The adjacent natural teeth were intact, vital and did not show increased mobility.

For radiographic examination, a maxillary anterior occlusal radiograph was taken together with a peri-apical radiograph. No abnormalities were detected on the occlusal radiograph. The peri-apical radiograph was closely compared with a peri-apical radiograph that was taken before the accident, just after placement of the crown. Distally, the implant-abutment interface showed a small triangular gap (Figs 2 and 3). It was suggested that the displacement of the implant crown was caused by deformation of the fixation screw. However, it was not certain that, besides this, the alveolar process surrounding the implant had been fractured, causing a displacement of the implant itself. As the aesthetics were still acceptable for the patient, an expectative policy was pursued. It was possible to leave the implant crown free from occlusion contacts by grinding the porcelain of the palatal aspect of the implant crown. The patient was instructed to follow a soft diet and to avoid force on the implant crown as much as possible. Follow-up visits 1 and 3 months later showed status quo. On the last visit, the one-piece screw-retained implant crown was removed. A torque wrench was necessary to loosen the fixation screw that was clearly bent (Fig. 4). A careful visual inspection of the implant platform and implant crown revealed that both were undamaged. For further investigation of the implant crown, it was installed on the original soft tissue cast with the aid of a laboratory fixation screw. It was found that there was a good fit with the implant analogue and that the implant crown was properly located in harmony with the adjacent dentition (Fig. 5). The palatal aspect of the implant crown that was grinded earlier was restored in the dental laboratory by fusing a new layer of porcelain. The implant crown was replaced on the implant and fixed with a new fixation screw. The implant–abutment interface was approved radiographically and finally the fixation screw was torqued. The screw hole was filled with a cotton pellet and composite resin (Fig. 6).

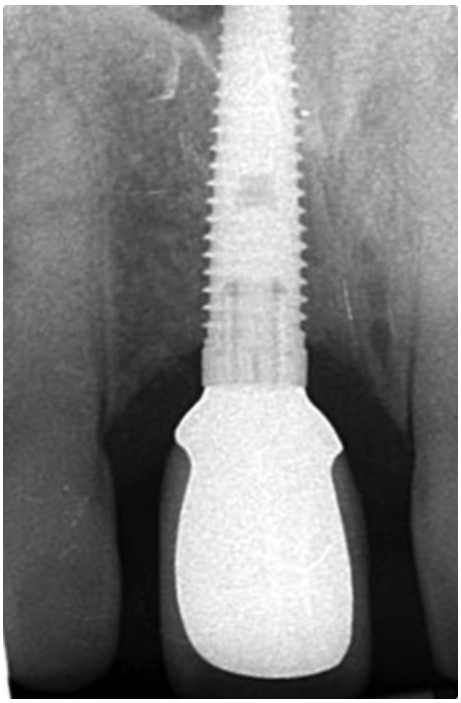

Fig. 2. Radiographic view after completion of implant therapy, before trauma.

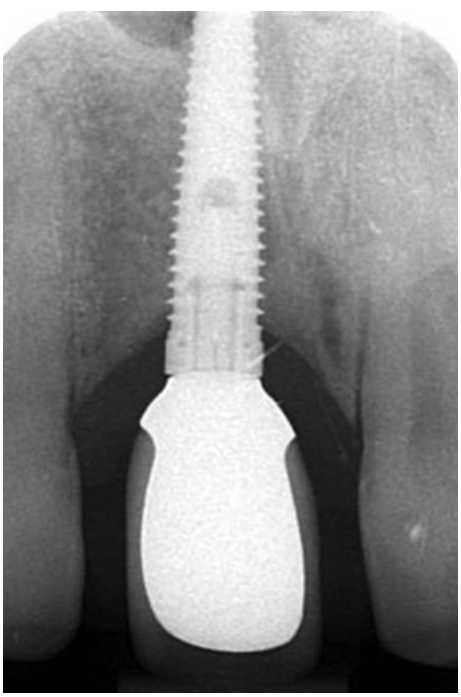

Fig. 3. Radiographic view after trauma. Note the small triangular gap at the distal implant–abutment interface.

Discussion

This report describes a case of trauma to an anterior implant-supported crown. It appeared that only the fixation screw had sustained damage. Apparently, a major part of the impact energy was absorbed by the

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Fig. 4. Bent fixation screw.

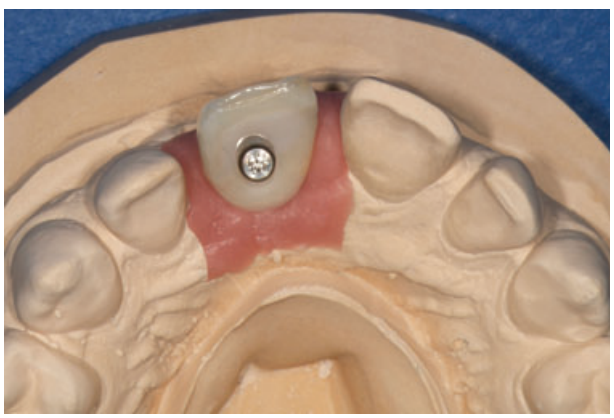

Fig. 5. One-piece screw-retained all-ceramic crown replaced on the original soft tissue cast. The crown is in harmony with the adjacent dentition.

Fig. 6. Clinical view after replacement of the crown with a new fixation screw.

deflection of the fixation screw, thereby saving the crown, implant and alveolar bone. Thanks to this protective mechanism, only a small prosthetic retreatment could restore the implant-supported crown. More complicated prosthetic retreatments or surgical retreatments in particular should be prevented as much as possible. We believe that the implant components could play an important role in preventing serious damage to the implant or surrounding tissues following an impact force.

With respect to the alveolar bone that surrounds the implant, it is known that although bone is able to absorb energy, a large force impact applied to an integrated implant, might lead to microcracking or fracture of bone (9). It is conceivable that as a result, displacement of the implant occurs, or even worse, an extensive fracture of the alveolar process. A study on the impact fracture resistance of implants and abutments showed that 16 out of 18 implants that were embedded in a bone-simulating material, remained intact and were displaced from the embedding material with fracture of the embedding material as a consequence (12). In only two specimens with zirconia abutments the abutments fractured. Assumed that the bone-simulating material is representative of alveolar bone structure, it was suggested that a facial trauma to an osseointegrated implant is likely to lead to fracture of the alveolar bone, leaving the implant intact. To what extent this would actually occur in the clinical situation is not known. Only one report described a displacement of an implant after trauma, probably in combination with fracture of the labial cortical bone (11). In this report, however, the traumatic incident was only 4 months after implant placement and the authors hypothesized that the peri-implant bone was not yet maturated and hardly organized, offering little resistance to force. Furthermore, it was argued that the low bone volume present at the implant region could be responsible for the implant displacement and possible fracture.

In our case, the trauma occurred 14 months after implant placement and although a pre-implant augmentation procedure was performed, the peri-implant bone resisted. It turned out that only the fixation screw was damaged. However, at the first consultation after trauma, we were not really sure if the bone surrounding the implant had not been fractured, also causing a displacement of the implant itself. As the aesthetics were still acceptable for the patient and it was possible to leave the implant crown free from occlusal forces, we decided to adopt an expectative policy allowing the peri-implant bone to rest.

Little is known about how the implant and superstructure generally react to an impact. If the superstructure has been damaged, this can be solved by repairing or replacing the relevant component, on the condition that it is possible to remove this component from the implant. However, if the implant has to be replaced because of damage or a non-removable component, a complex surgical retreatment is needed with much inconvenience for the patient. In the study by Silva et al. (12), also impact tests were performed on implants clamped in brass. They found that for implants with titanium abutments, an impact leads to fracture of the abutment screw leaving the abutment and implant intact. Zirconia abutments, however, fractured in pieces, but no damage of the implant and abutment screw was observed. It should be noted that in this study, implants with an external implant–abutment connection were tested. Implant systems with internal abutment connections

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might react differently to an impact, but to our best knowledge, impact tests on these connections are lacking in literature. On the contrary, several studies investigated the strength of different implant–abutment connections under compressive loading tests. These studies could provide valuable information about the stability of implants under high forces. It was found that abutments and abutment screws fractured or bent, whereas most of the implants remained intact or showed only little damage (13–17). This implies that under high forces, the implant is not the weakest link and might remain standing after an impact. However, a comment should be made on implants with a smaller diameter. Finite element stress models in which implants with an internal connection were subjected to oblique compressive loading showed that especially implants with a narrow diameter (3.3 mm) are at risk to fracture under bending forces, as high stresses concentrated at the implant collar (18, 19). Implants with a regular diameter (≥4 mm) showed a more favourable stress distribution with lower stresses at the implant collar (18). In our case, the patient was restored with a Replace Select Tapered implant and a NobelProcera zirconia abutment was used for the restoration. Att et al. (20) evaluated the fracture strength of implant-supported all-ceramic restorations under compressive loading, for the same abutment and implant system. After the load-to-fracture tests, no implant collar distortion was found for all of the specimens.

It was of advantage that our patient was restored with a one-piece screw retained crown, as it was easy to remove and could be used again. Cement-retained implant crowns are hard to remove without sacrificing crown material. Furthermore, it proved to be helpful that we had documented the implant treatment completely, including the radiographic documentation at various stages and that we kept the original soft tissue cast on which the final crown was fabricated.

Although the incidence of trauma to implant-supported restorations is not high, the patient deserves a careful approach that is well thought. The same is true for preventing irreversible damage leading to complicated prosthetic or surgical retreatments. To our opinion, the superstructure should be the weakest link if an implant-supported restoration is subjected to a traumatic impact, thereby preserving the implant and surrounding tissues. Most ideally, the fixation screw absorbs most of the energy thereby protecting the crown, abutment and implant. Moreover, it is important that damaged implant components can be removed from the implant, so that a prosthetic retreatment is feasible. Therefore, more research would be helpful to explore the consequences of an impact to implant systems and corresponding implant components.

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