Occurrence of Maxillary Central Diastema between Tooth-supported and Implant-supported Prostheses: a 5-year Clinical Follow-up

De Li LI[1], Shi Ying LI[1], Zhi Hui TANG[1], Yu Wei WU[1], Liang Zhong LI[1]

A 27-year-old patient with a history of maxillary anterior tooth trauma presented with a maxillary central diastema between tooth- and implant-supported prostheses that had been in use for 5 years. The all-ceramic crowns were placed in 2012 after rigorous occlusal adjustment. Evaluations were carried out at 0, 2, 3, 4 and 5 years post restoration. The central diastema between the natural teeth and the implant-supported prosthesis on teeth 11 and 12 was first observed 2 years after implantation. After 5 years, the distance was found to have increased, with anterior occlusion and esthetic changes having taken place. The following possible causes were discussed: occlusal problems, anterior traumatic effects, the possible impact of guided bone regeneration (GBR) on the adjacent natural teeth and natural movement. More predictive information should be given to patients with implant-supported prostheses and natural teeth so that they are fully informed of the impact of any necessary clinical compromise and are aware of the modifications that may occur to their natural dentition.

Key words: *central diastema, implant-supported prostheses, follow-up, osseointegrated implants*

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Osseointegrated implants have been widely studied and safely applied in modern dentistry[1]. The main goal of this technique is to increase the stability of prostheses during the masticatory function and improve the quality of life of the patient, especially regarding the condition of the anterior teeth. Nonetheless, after years of use of osseointegrated implants and implant-supported prostheses, some problems have been reported in the literature, including the loosening and fracture of screws as well as fracture of the prostheses and implants[2]. More recently, some cases of misalignment between maxillary anterior implant-supported crowns and adjacent natural teeth caused by adult growth have also been reported[3].

This article describes a central diastema that occurred between maxillary natural teeth and implant-supported prostheses, possibly due to traumatic and de-cortical effects. The photographs in this article were taken at the installation visit and after 2, 3, 4 and 5 years of function.

Clinical case report

The patient described in this case suffered a traffic accident at the age of 22 years, with consequent crown root fracture of tooth 21 and crown fracture of teeth 11, 22 and 23. Subsequently, tooth 21 was extracted and teeth 11, 22 and 23 underwent root canal therapy (Fig 1). A 4.0 × 11.5 mm implant (Certain Prevail, Biomet 3i, US) was placed in July 2011. During stage 1, extraction surgery was performed on tooth 21. Three months later, during stage 2, implantation and GBR surgery was com-

1 2nd Dental Center, Peking University School and Hospital of Stomatology, National Engineering Laboratory for Digital and Material Technology of Stomatology, Beijing Key Laboratory of Digital Stomatology, Beijing, P.R. China.

Corresponding author: Dr Yu Wei WU and Dr Liang Zhong LI, 2nd Dental Center, Peking University School and Hospital of Stomatology, B5 Anli Garden, #66 Anli Road, Chao Yang District, Beijing 100101, P.R. China. Tel: 86 10 82196299; Fax: 86 10 64907970. Email: yuweiwu@bjmu.edu.cn, liliangzhong2006@sina.com

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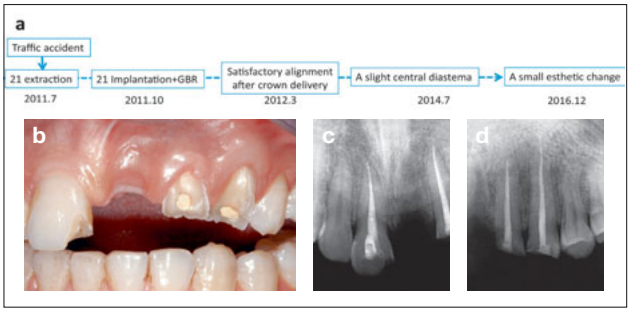

Fig 1 Diagram detailing the entire case procedure. **(a)** Preoperative intraoral photograph **(b)** and radiographic views **(c and d)** of the missing maxillary left central incisor.

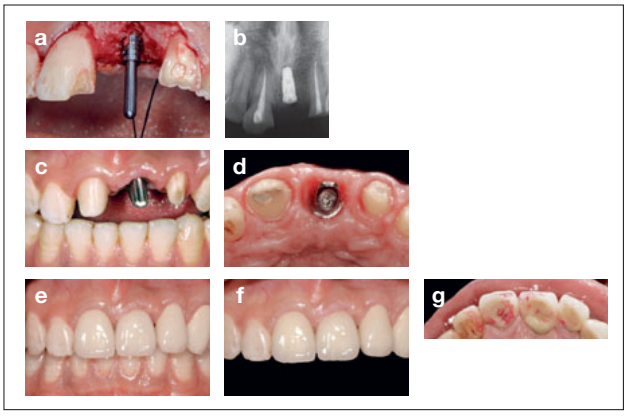

Fig 2 Intraoral **(a)** and radiographic **(b)** view of left central incisor implantation surgery before **(c and d)** and after **(e and f)** crown delivery; satisfactory alignment between the four crowns and the maxillary teeth can be observed on the buccal view after the installation. The implant-supported crown was given a smaller occlusal contact area so that there was a smaller load than in the contralateral natural tooth **(g)**.

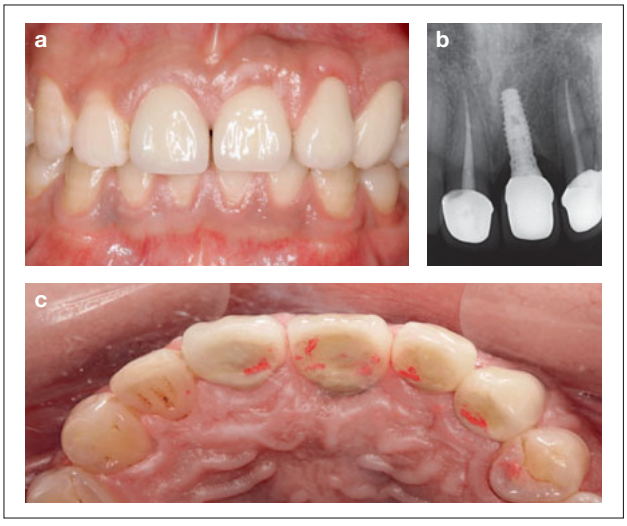

Fig 3 Cementation of crowns after 2 years and 3 months. Central diastema between the implant crown and the natural teeth 2 years and 3 months after cementation **(a)**; implant radiographical examination **(b)**; a slightly larger occlusal contact area of the implant crown compared with the contralateral natural teeth, indicating the labial movement of tooth 11 **(c)**.

pleted (Fig 2a and b). All-ceramic crowns for tooth 21 (TempBond; Kerr Dental, Orange, CA, US) and teeth 11, 22 and 23 were cemented 5 months after implantation (March 2012). The satisfactory alignment between the four crowns and the maxillary teeth after the installation can be observed on the buccal view image (Fig 2c to e). The implant-supported crown was intentionally given a smaller occlusal contact area so that there was a smaller load than in the contralateral natural tooth (Fig 2 g).

A recall examination was performed 2 years 3 months after the cementation of the crowns (July 2014). The crowns had not been removed or adjusted after cementation, and no dental treatment was provided to the other anterior teeth. A slight central diastema between the crowns of teeth 11 and 21 was noticed (Fig 3a). No mobility or loss of cement on the crown was found, and no pathology was present radiographically (Fig 3b). The periodontal condition was good, with a pocket probing depth of 3 mm or less and no bleeding on probing. The position of tooth 11 had shifted slightly labially compared with its position at the time of cementation. It was also found that with the other three crowns (including tooth 21), the implant-supported crown had more occlusal contacts than before (Fig 3c).

In December 2016 (5 years and 2 months after implantation, 4 years and 9 months after restoration), the patient returned for another follow-up visit. Apart from the central diastema that had caused a small esthetic problem, the dental examination showed no mobility of the implant or the prosthesis (Fig 4). As the patient had no complaints, no further treatment was carried out.

Discussion

The clinical situation of a central diastema between natural teeth and an implant prosthesis after long-term restoration is not reported very often in the literature, especially in patients older than 20 years. This case is therefore particularly important as regards rehabilitation with osseointegrated implants. The esthetics may become compromised, and the functionality of the stomatognathic system may be impaired.

Effect of adult growth on the anterior maxilla

In 1996, Bishara et al[4] reported changes in the dental arches and dentition that occur in mid-adulthood. Evaluations and measurements were made from dental casts and radiographs of 15 women and 15 men, ranging in age from approximately 25 to 46 years. Significant changes were seen in the maxillary and mandibular dental arch-

es and the dentition of both the men and women. The changes included an increase in tooth size–arch length discrepancy, which resulted in a significant increase in dental crowding in both arches. The authors concluded that the findings suggested that age-related changes in the dental arches do not cease with the onset of adulthood, but continue, albeit at a slower rate, throughout adult life. These changes were evident in the patient case presented here (Figs 1 to 4); the implant-supported crown appeared stable and somewhat palatal relative to the adjacent natural central incisor. It seems likely that the ankylosed implant prevented the alveolar bone from immediately remodelling and inhibited normal growth elsewhere in the jaws.

Fig 4 More occlusal contacts on the implant prosthesis of tooth 21 and the crowns of teeth 22 and 23 at the 5-year follow-up visit.

Occlusal load on implant region

Implant prostheses probably have a greater occlusal load than natural teeth at higher clenching intensities because they lack the mechanical buffering function of the periodontal membrane[5]. There is a school of thought that believes prosthetic implants should be given a lower occlusion than natural teeth[6-8]. In the present case, the initial occlusal load on the implant prosthesis tended to be lower than that of the contralateral tooth at higher clenching strengths (Fig 2 g). This was further confirmed by the labial movement of tooth 11 and the smaller contact point under the overloaded biting force (Fig 3c). This may have been one of the causes of the central diastema. When considering the balance of the occlusal load in the anterior region, it may be better to ensure the same occlusal load. This idea is in line with the occlusal dynamic imbalance between natural teeth and implants when they are subjected to an occlusal force because of different levels of tissue displaceability[3,5,7,9,10].

However, a fracture was observed in the porcelain on the crown of tooth 23, suggesting parafunction. Parafunction such as bruxism can give rise to overloading on the teeth, which may cause dental fracture, loss, tooth wear and tooth migration[11]. The large occlusal load on tooth 11, possibly combined with overloading due to bruxism, may have contributed to the labial movement.

Different connection modes to alveolar bone between teeth and implants

The teeth are connected to the bone tissue by the periodontal ligaments (PDLs). Through bone remodelling, the PDLs allow the movement that results in bone tissue being resorbed and new bone being formed[12]. Osseointegrated implants, unlike natural dentition, do not biologically migrate and show a slow, continuous eruption, as observed in young adult patients whose permanent teeth may or may not have totally erupted. Even during adulthood, after the growth phase has ended, dentofacial changes caused by constant bone remodelling that occurs throughout life are still observed[4]. The teeth move in harmony with this bone remodelling pattern because of the PDLs. The same is not true of dental implants, and this causes the discrepancies in their positioning in relation to the natural teeth. This also occurs because implant-retained prostheses do not become secondarily displaced in space the way teeth do during the growth of the maxilla.

Possible impact of GBR on adjacent natural teeth

During the GBR process in the present case, to ensure sufficient blood supply and the specific effects of bone augmentation, small holes were drilled in the buccal alveolar cortical bone around the operation region, as is done with corticotomies. Corticotomies, a surgical procedure to accelerate tooth movement, are used during orthodontic treatment to reduce the treatment time[13]. In the present case, the implant area, including the buccal tooth 11, was drilled and received bone implantation, which under some circumstances (similar to corticotomies) may promote labial tooth movement. The natural teeth were given a larger occlusal contact area than the implant-supported restoration during the occlusal adjustment. The relatively high load on the right central incisor is similar to the orthodontic forces that control tooth movement. This may have been the reason for the labial movement of tooth 11 under the combined corticotomies of the GBR and larger orthodontic force of the occlusal load.

Possible influence of oral parafunction

Bruxism and other similar masticatory system activity causes dental fracture, loss, and the wearing down of enamel or teeth. A fracture was observed in the porcelain of the crown of tooth 23, suggesting parafunction. Parafunction such as bruxism will also cause overloading of the anterior teeth.

Conclusion

The importance of regular follow-up appointments after the delivery of a rehabilitation is strongly emphasised. Despite the low incidence of the issue presented in this article, patients seeking treatment for osseointegrated dental implants in the anterior region should be informed of the possibility of adjacent position changes between the teeth and the implant-supported prosthesis.

Conflicts of interest

The authors reported no conflicts of interest related to this study.

Author contribution

Drs De Li LI, Yu Wei WU and Liang Zhong LI performed the clinical treatments; Drs Shi Ying LI and Yu Wei WU wrote the manuscript; Dr Shi Ying LI collected the data; Dr Zhi Hui TANG revised the manuscript. De Li LI and Shi Ying LI contributed equally and shared the first authorship. All authors approved the final manuscript for submission.

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