A new regenerative treatment for tooth and periodontal bone defect associated with posttraumatic alveolar bone crush fracture

Kensuke Kiyokawa,MD,PhD[*1] , Munekatsu Kiyokawa ,DDS[*2],Mikako Takagi ,MD[*1], Hideaki Rikimaru ,MD PhD[*1] , Takuji Fukaya, DDS[*2]

＊1 Department of Plastic and Reconstructive Surgery and Maxillofacial Surgery, Kurume University School of Medicine, Fukuoka, Japan

＊2 Kiyokawa Dental and Oral surgical Clinic, Fukuoka, Japan

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Correspondence to: Kensuke Kiyokawa, MD,PhD, Department of Plastic & Reconstructive Surgery and Maxillofacial Surgery, Kurume University School of Medicine ,67 Asahi-machi, Kurume-shi, Fukuoka 830-0011, Japan.

TEL; 81-942-31-7569

FAX ; 81-942-34-0834,

E-mail ; prsmf@med.kurume-u.ac.jp

Abstract

We developed a new regenerative treatment for tooth and periodontal defect and tooth dislocation associated with posttraumatic alveolar bone crush fracture in the region of the maxillary anterior teeth. Using this method, dislocated teeth are first extracted and crushed alveolar bone is debrided. The dislocated teeth are then reimplanted and cancellous iliac bone (bone marrow) is grafted to the area surrounding the teeth to regenerate periodontal bone. Tooth reimplantation was completely successful in 2 cases, and periodontal bone regenerated to a sufficient height with the iliac bone graft. Compared to the general method of treatment with a prosthesis (bridge), when using this method to treat cases such as these there is no sacrifice of healthy teeth adjacent to the defect, and sufficient esthetic and functional recovery is possible. It is thought that this method could be applied as a new treatment for alveolar bone fracture in the future.

Introduction

Severe alveolar bone fracture is usually treated by extracting dislocated, loose teeth and debriding crushed alveolar bone, followed by the fitting of a prosthesis (bridge). With this treatment, however, in addition to loss of the dislocated teeth, it is necessary to shave two healthy teeth on each side of the defect, for a total of four teeth, to create abutment teeth for the bridge. Taking into consideration the fact that teeth shaved to form abutment teeth do not last as long as untreated healthy teeth, treatment using a bridge results in a large, long-term sacrifice for the patient.

For patients with marked absorption of alveolar bone associated with severe periodontal disease and giant cystic lesion of the mandible, we have performed regenerative treatment using tooth reimplants and cancellous iliac bone (bone marrow) to obtain almost satisfactory results [1,2]. Applying these methods of regeneration, we developed and performed a new regenerative treatment for tooth and periodontal bone defect and dislocated teeth associated with posttraumatic alveolar bone crush fracture in the region of the upper anterior teeth. Using this method enables sufficient esthetic and functional recovery without sacrificing healthy teeth. This is a report of the actual advantages of this new method.

Methods

Before operating, loose teeth due to dislocation are extracted and soft tissue surrounding the dental root, including the periodontal membrane, is removed and pulpectomies are performed. The first operative procedure is to make an incision in the necrotic region of the alveolar bone fracture at the alveolar crest. From there, proceed to separate the gum to the subperiosteum, elevating it as a gingival flap while broadly exposing the fractured part of the alveolar bone. After complete debridement of crushed alveolar bone and scar tissue, the teeth are reimplanted. In many cases the teeth are reimplanted in their original position, but they may also be reimplanted in another location. Next, the required quantity of cancellous iliac bone (bone marrow) is harvested and used to fill not only the areas surrounding the roots of the teeth but also all of the areas of periodontal defect resulting from debridement. The gingival flap is then stretched and

sutured to complete the operation (Fig 1). At about postoperative month 3 or 4, after verifying that the reimplanted teeth and grafted iliac bone are firmly anchored, abutment teeth are prepared and a bridge is fitted to enable mastication to commence.

Case 1

Case: 24-year-old male
Chief complaint: Lost and loose anterior teeth
Past medical history: Nothing of note
Current medical history: Injury to anterior teeth in a traffic accident 4 months before.
Findings at initial hospital presentation: Posttraumatic alveolar bone fracture, with missing upper right first incisor and alveolar bone defect in the same area, fractured upper right second incisor, and dislocation of upper left first and second incisors observed. There was also edge-to-edge occlusion of the anterior teeth resulting in marked mobility of the upper anterior teeth when touching the lower teeth during mastication (Fig 2A,B).
Initial radiographic findings: Periodontal defect and crush fracture in the area of the upper anterior teeth were observed (Fig 2C).
Treatment and course: The day before operating, the loose upper left first and second incisors near the bone fracture and the fractured upper right second incisor were extracted and a pulpectomies were performed. The first step of the operation was to correct the edge-to-edge occlusion of the anterior teeth by extracting the first lower left premolar and performing an anterior segmental osteotomy to move the lower anterior teeth about 4 mm back. This improved the positional relationship between the alveolar arch of the maxilla and mandibula to thereby improve the edge-to-edge occlusion (Fig. 2D). Next, an incision was made at the alveolar crest from the second upper right incisor to the second upper left incisor at the site of the bone fracture, and the gum was broadly separated to the subperiosteum to create a gingival flap. After debriding crushed alveolar bone and scar tissue, the depulped first and second upper right incisors and second upper left incisor were reimplanted, and the first lower left premolar extracted to improve edge-to-edge occlusion was transplanted in the location of the

missing first upper right incisor. Cancellous iliac bone including a large quantity of bone marrow was used to fill the areas surrounding the roots of the reimplanted and transplanted teeth as well as the entire area of periodontal defect. Finally, the gingival flap was stretched and sutured to completely cover the grafted iliac bone.

The 3 reimplated teeth and 1 transplanted tooth and the iliac bone became firmly attached without any complications. At postoperative month 4, after verifying that the reimplanted and transplanted teeth and grafted iliac bone were firmly anchored, abutment teeth were prepared (Fig 2E), and a bridge was fitted (Fig 2F). Edge-to-edge occlusion was improved and satisfactory functional and esthetic results were obtained.

Postoperative radiographic findings: At postoperative year 1, radiographs verified that the reimplanted and transplanted teeth were attached and alveolar bone had regenerated.

Case 2

Case: 16-year-old female

Chief complaint: Loss of anterior teeth

Past medical history: Nothing of note

Current medical history: Injury to anterior teeth in a traffic accident 4 months before. Four days after injury received treatment at a local medical institution for facial bones fracture.

Findings at initial hospital presentation: Posttraumatic alveolar bone fracture, with fractured first upper left incisor, and lost first and second upper right incisors with periodontal loss observed in the same location (Fig 3A). There was also edge-to-edge occlusion of the anterior teeth.

Initial radiographic findings: Periodontal defect and crush fracture in the area of the upper anterior teeth were observed (Fig 3B).

Treatment and course: The day before operating, the fractured first upper right incisor in the region of the bone fracture was extracted and a pulpectomy was performed. The first step of the operation was to correct the edge-to-edge occlusion of the anterior teeth by extracting the second lower left premolar and performing an anterior segmental osteotomy to move the lower anterior teeth about 4 mm back. This improved the positional relationship between the alveolar arch of the maxilla and

mandibula to thereby improve the edge-to-edge occlusion. Next, an incision was made at the alveolar crest from the upper right canine to the upper left canine, and the gum was broadly separated to the subperiosteum to create a gingival flap. After debriding crushed alveolar bone and scar tissue, the second lower left premolar extracted to improve edge-to-edge occlusion was transplanted in the location of the lost first upper right incisor, and an allotransplant of a tooth from her mother was performed to replace the lost first upper left incisor. Cancellous iliac bone including a large quantity of bone marrow was used to fill the areas surrounding the roots of the reimplanted and transplanted teeth as well as the entire area of periodontal defect. Finally, the gingival flap was stretched and sutured to completely cover the grafted iliac bone.

The reimplated and allotransplanted teeth and the iliac bone became firmly attached without any complications. At postoperative month 4, after verifying that the reimplanted and allotransplanted teeth and grafted iliac bone were firmly anchored, abutment teeth were prepared and a bridge was fitted. Edge-to-edge occlusion was improved and satisfactory functional and esthetic results were obtained (Fig 3C).

Postoperative radiographic findings: At postoperative month 18, radiographs verified that the grafted teeth were attached and alveolar bone had regenerated (Fig 3D).

Discussion

The method reported here also enables regeneration of alveolar bone in cases where there is extensive defect, such as complete loss of alveolar bone due to severe periodontal disease 1). At the same time, because anterior teeth are anatomically located on the front of the face, they are often subjected to external forces due to traffic accidents, sports accidents and acts of violence. In many cases, this results in fracture of the alveolar bone in the region of the anterior teeth, and dislocation or loss of teeth. Many people receive medical treatment for lost teeth and damage to the alveolar bone following trauma to the anterior teeth. In general, the treatment for alveolar bone fracture involves extraction of teeth loosened by dislocation, debridement of crushed alveolar bone and suturing of the gum, followed by fitting of a bridge to compensate for lost teeth. When

fitting a bridge in this way, 1 or 2 healthy teeth either side of a missing tooth are shaved and used as abutment teeth for the bridge. Consequently, as well as losing teeth in the region of alveolar bone fracture, patients also have to sacrifice 2 to 4 healthy teeth that are shaved for the bridge. Since the teeth that are used as abutment teeth are shaved, they lose their surface coating of enamel. As well as making them more susceptible to tooth decay, this also makes resorption of the dental root more likely if strong masticatory force is applied. This means that early loss of healthy teeth is highly possible. For young patients, when viewed over the medium to long term, this is a considerable sacrifice, and as such is an extremely unacceptable treatment. At present, however, there is no other option.

By comparison, the method reported here offers the advantages of not requiring the sacrifice of even 1 healthy tooth while providing both satisfactory functional and esthetic results. Furthermore, even if a transplanted tooth is lost due to dental root resorption (replaced by bone) in the future, since sufficient regeneration of the alveolar bone is possible, another implant [3)~5)] can be embedded.

There was another problem with the 2 cases presented in this report. As well posttraumatic alveolar bone fracture in the region of the upper anterior teeth, there was the preexisting complication of edge-to-edge occlusion of the anterior teeth (Fig 2B). In such cases of edge-to-edge occlusion, if a bridge is fitted in the actual location of the anterior teeth, upward pressure exerted by the lower anterior teeth soon loosens the bridge until it eventually becomes damaged. This also has a significant influence on the healthy teeth used as abutment teeth, and can lead to loss of these teeth earlier than would normally be expected. If by necessity a protruding upper bridge is constructed, that is, one giving the impression of protruding teeth, this presents esthetic problems (Fig 4a). To avoid this, an anterior segmental osteotomy was performed in both cases to correct the edge-to-edge occlusion, and a favorable occlusion was obtained (Fig 2d). In addition, extracting a lower jaw tooth during the osteotomy and transplanting it in the location of a lost tooth in the upper jaw enabled maximum use of the patient's own tissue with no unnecessary waste.

If the application of this method becomes more widespread, it may be possible to treat not only teeth loosened due to alveolar bone crush fracture, but also, with cooperation between a dental surgeon and a plastic and

reconstructive surgeon, to treat teeth lost due to external trauma in the same way as reported here by preserving the lost teeth in liquid nitrogen and performing surgery at a later date. When performing this treatment, during the acute period immediately after trauma, problems include circulatory disorders and postoperative infection due to gingival injury or other causes, and the availability of staff to conduct surgery. For this reason, it is best to begin treatment at a time determined by the staff several months later when soft tissue, including gum, has completely recovered.

Requiring no need for sacrifice of a patient's healthy teeth and enabling regeneration of alveolar bone to almost its original condition, this method is considered to be an extremely innovative approach to treatment.
To obtain successful results when using this method, it is important that it is conducted by a medical team comprising a dental surgeon well versed in occlusion, tooth transplants and implants, and a plastic and reconstructive surgeon well versed in creating gingival flaps and iliac bone grafts [6-16]. With planning by the dental surgeon to obtain favorable occlusion and tooth implant precision, and regenerative treatment by the plastic and reconstructive surgeon using iliac bone grafts, this method could further expand the possibilities for treating external trauma.

Conclusions

Rather than fitting a conventional bridge to treat tooth and periodontal bone defect associated with posttraumatic alveolar bone fracture in the region of the upper anterior teeth, by combining regenerative treatment with surgical orthodontics it was possible to obtain almost satisfactory functional and esthetic results using the patients own tissue. Providing a large improvement in patient QOL, this method is thought to be extremely useful for the treatment of tooth loss and dislocation associated with posttraumatic alveolar bone crush fracture.

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Figure legends

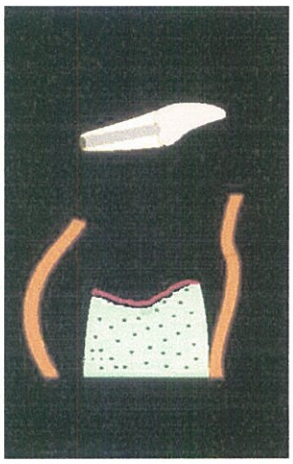
Figure 1
Schema of operative procedure
a. Preoperative condition. Alveolar bone crush fracture.
b. Intraoperative condition. Tooth extraction and root canal treatment. Debridement of crushed bone and scar tissue.
c. Postoperative condition. After tooth reimplant, extensive filling of the entire area of periodontal bone defect resulting from debridement with cancellous iliac bone (bone marrow). Complete covering of the grafted bone with a gingival flap.

Figure 2
Case 1 24-year-old male, alveolar bone crush fracture in the region of the upper anterior teeth
a. Preoperative intraoral findings.
b. Schema of preoperative edge-to-edge occlusion.
c. Preoperative radiographic findings.
d. Schema of this case's upper anterior segmental osteotomy,and tooth reimplant.
e. Finding after preparing abutment teeth at postoperative month 4.
f. Findings at postoperative year 1 after performing final prosthetic treatment.
g. Radiographic findings at postoperative year 1.

Figure 3
Case 2, 16-year-old female, alveolar bone crush fracture in the region of the upper anterior teeth
a. Preoperative intraoral findings.
b. Preoperative radiographic findings.
c. Findings at postoperative month 8 after performing final prosthetic treatment.
d. Radiographic findings at postoperative month 18.

図1

a



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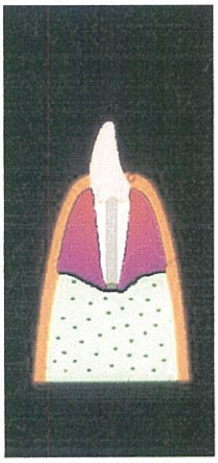

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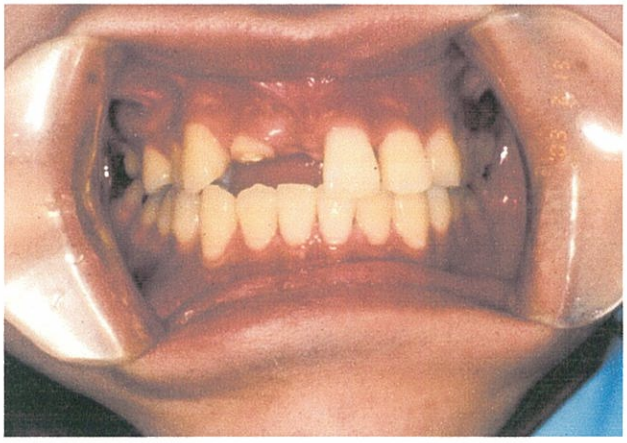

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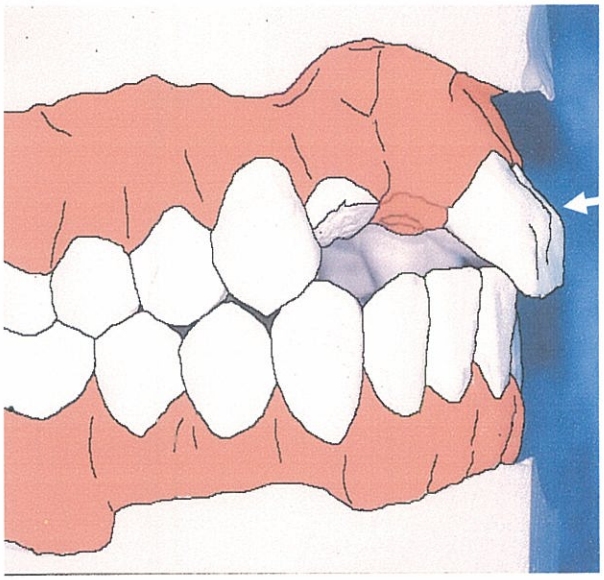
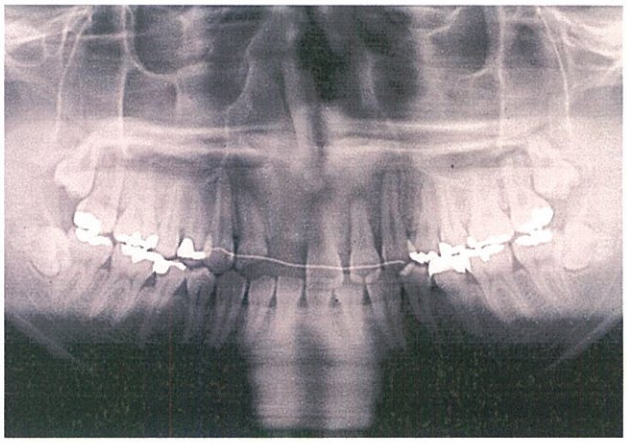


図2b

切端交合による左上
１，２番の動揺



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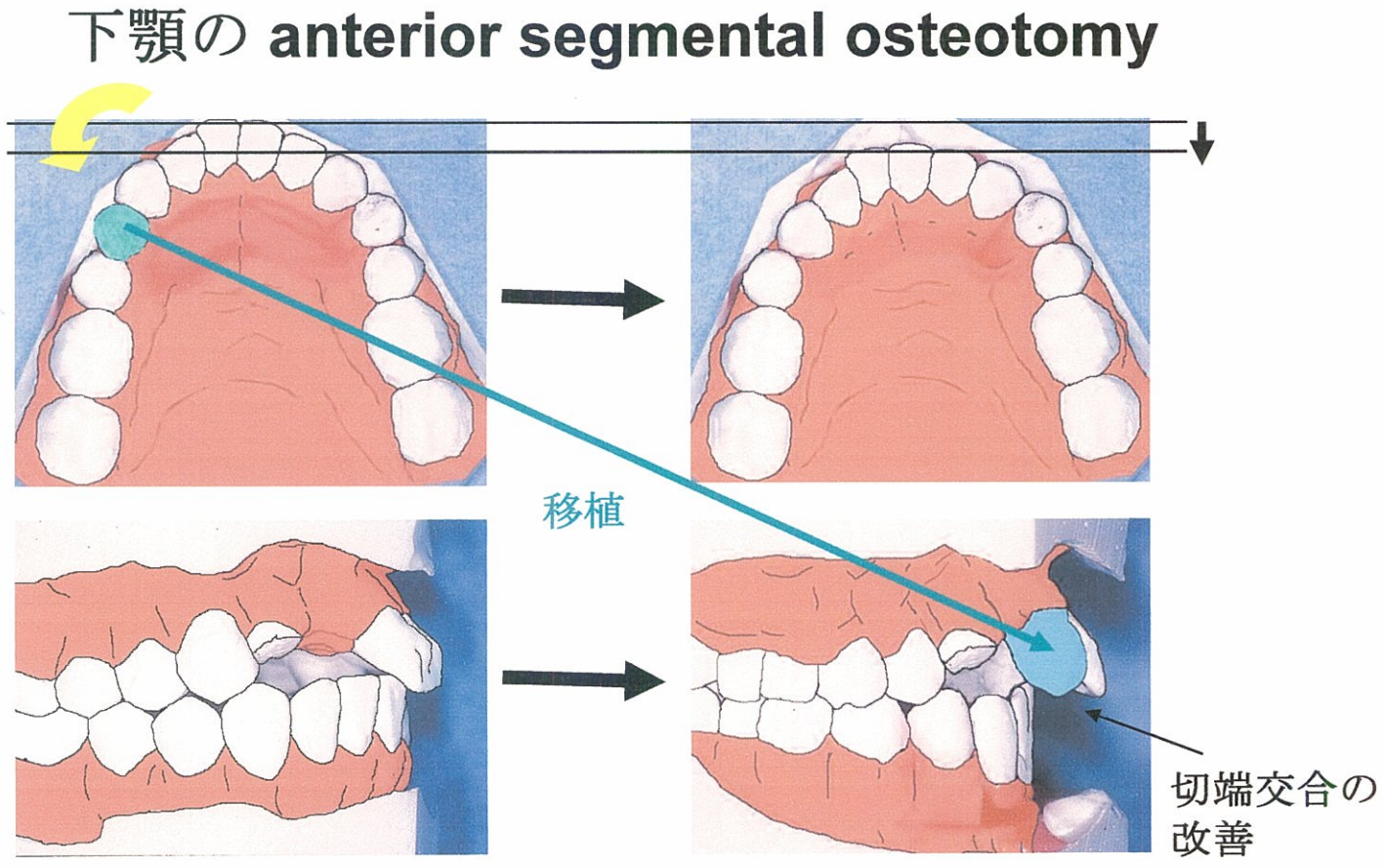
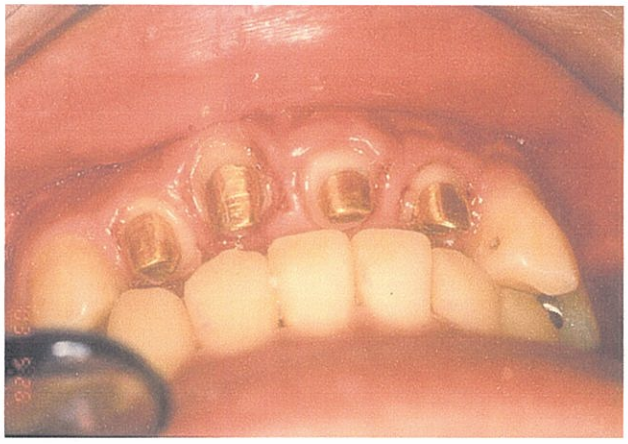


左下４番を抜歯し下顎前歯部を後退

図2d



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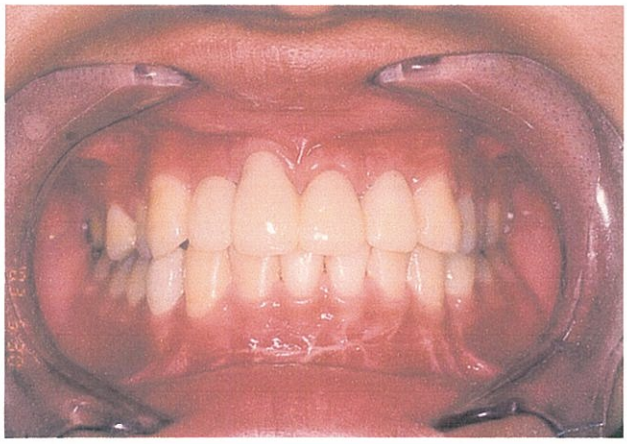
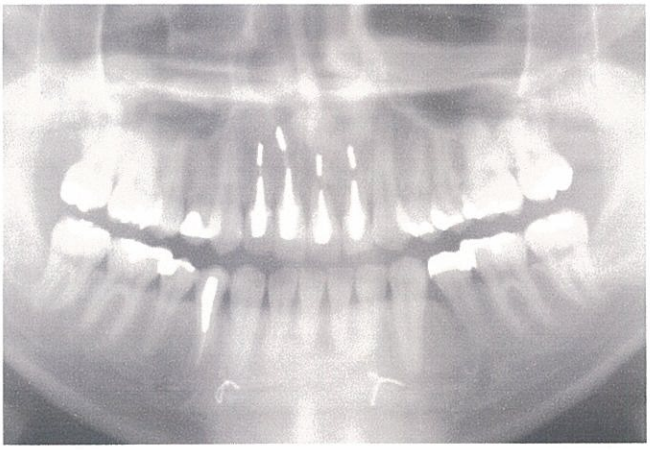


図2f



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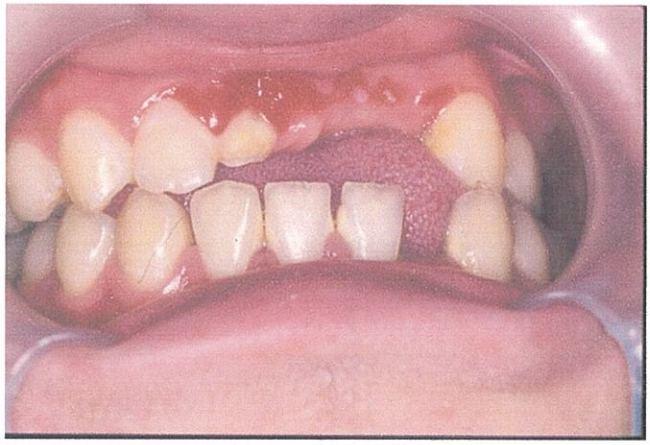

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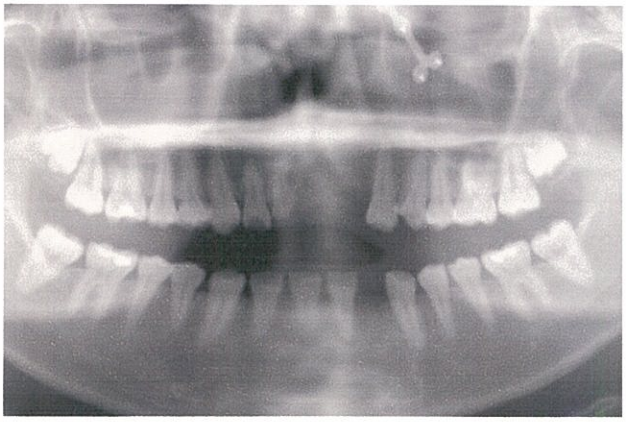

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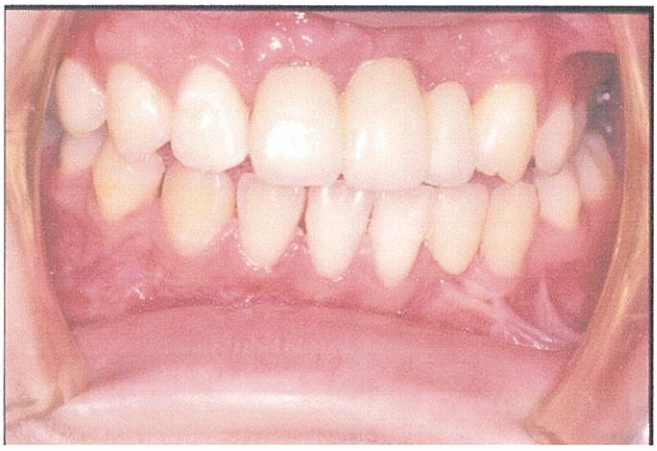

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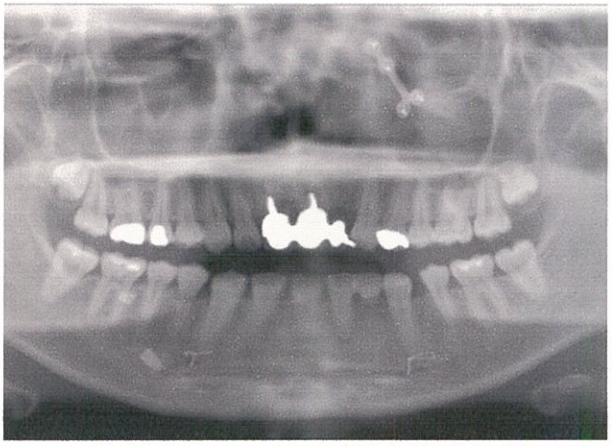

図3d