A Single-Visit Technique for Fabricating Interim, Immediately Loaded Implant-supported Full-arch Prostheses with Prefabricated Rigid Connecting Bars: a Case Report

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Traditional techniques for fabricating interim, immediately loaded implant-supported full-arch prostheses are complex and time-consuming. The present study presents an efficient technique for fabricating interim prostheses with prefabricated multipurpose rigid connecting bars. This technique can minimise the misfit attributed to the polymerisation shrinkage of resin and expansion of the working cast, and simultaneously facilitate impression taking and occlusal records in one visit, thus reducing laboratory and chair time. Due to its ease of use and clinical efficiency, the present technique is considered particularly beneficial for immediate loading rehabilitation.

Key words: *dental implant, full-arch, immediate loading, implant impressions, interim prostheses*
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Immediate loading of implant-supported interim prostheses has become a reliable treatment modality for completely edentulous patients. The interim prosthesis splints the implants together, which allows for favourable force distribution in the peri-implant tissues and minimises the micromovement of the implants[1,2]. Prosthesis misfit is particularly risky in immediate loading rehabilitations in the first 2 to 3 weeks after implant insertion.

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Several procedures have been used to fabricate an interim prosthesis immediately after surgery. The conventional method involves a preliminary impression being made in the clinic, followed by fabrication of a stone cast and personalised impression copings in the dental laboratory[3]. After splinting the impression copings in the mouth, a pickup impression with rigid impression materials is taken to fabricate an accurate final cast. This whole procedure is complex and time-consuming, and the fracture or distortion of the splint materials caused by polymerisation shrinkage may affect accuracy in the definitive impression[4]. The interim prosthesis can also be fabricated by direct conversion of an existing complete denture or using an intraorally welded titanium framework[5-6]; however, the intraoral connection processes are skill dependent and uncomfortable for patients. The resin used for connection may have a negative impact on soft tissue healing and increase the risk of wound swelling and infection. Moreover, with the development of CAD/CAM technology, a digital workflow has been considered an efficient modality to fabricate precise prostheses. Taking digital impressions using intraoral digitisers simplifies

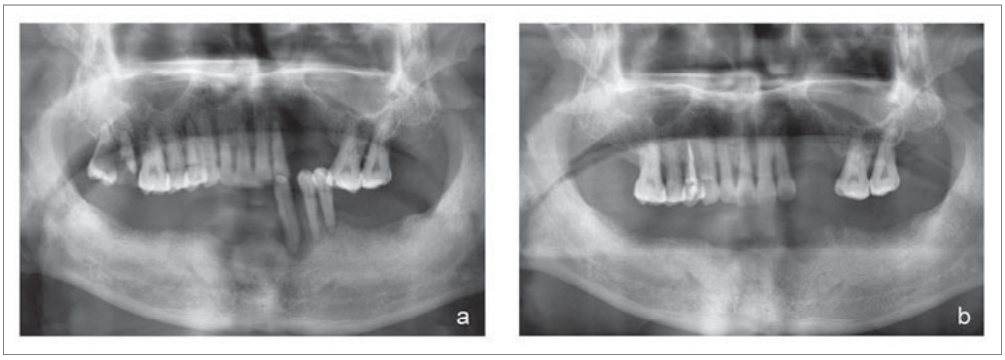

Fig 1 **(a)** Pretreatment panoramic radiograph; **(b)** panoramic radiograph of the patient before surgery.

the workflow greatly but presents disadvantages, namely the high initial economic investment and the steep learning curve for clinicians[7-8]. Thus, due to the limitations of conventional procedures, this article presents an immediate loading technique to facilitate the same-day adaptation of an implant-supported, screw-retained, full-arch prosthesis with prefabricated rigid connecting bars. With this technique, the non-tray pickup impression and occlusal records can be made simultaneously, reducing operative time and improving patient comfort.

Case report

A 64-year-old man presented with the chief complaint of difficulty chewing because he had lost most of his mandibular teeth. He had had diabetes for 5 years and was controlling it well with medication. Around 10 years previously, he had received a removable partial denture, but in recent years he had lost multiple teeth one after another and the old denture had come loose. On oral examination, the three remaining mandibular teeth, namely the left canine and first and second premolars, were extremely loose, and the periodontal probing depth was greater than 8 mm. A panoramic radiograph showed that the alveolar bone had been resorbed to the root apex (Fig 1a). In the maxilla, the left canine and first and second premolars were missing, and there were soft tissue and bone defects in both horizontal and vertical directions. The maxillary right second and third molars had hopeless residual crowns. A large cavity and periapical inflammation could be observed on the maxillary right first premolar. The other maxillary teeth had moderate periodontitis.

The patient was not satisfied with his old removable partial denture for both aesthetic and functional reasons and wanted a stable and functional outcome using implant-supported fixed restorations. He also wanted a denture to stay in place over the entire treatment period for professional reasons. Thus, a comprehensive treatment plan was proposed, which comprised the following steps:

- removal of the mandibular left canine and first and second premolars and the maxillary right second and third molars and relining the old removable partial denture;
- periodontal treatment of the remaining teeth and root canal treatment of the maxillary right first premolar;
- insertion of six implants (SPI Element RC; Thommen Medical, Grenchen, Switzerland) in the healed mandibular bone using the immediate loading technique;
- fabrication of an implant-supported fixed final prosthesis for the mandibular edentulous arch and a removable partial denture for the maxillary partially edentulous arch.

The patient's remaining mandibular teeth were extracted. After 3 months, a panoramic radiograph was taken to evaluate his residual alveolar bone (Fig 1b). Six implants were placed in the patient's edentulous mandible with a primary stability of 35 Ncm (Fig 2). The implants were cylindrical in shape with ISO 9268 trapezoidal threads, moderately rough sandblasted and acid-etched (SLA) surfaces and a 1.0-mm smooth collar. A complete set of stainless-steel rigid connecting bars of standardised size (thickness 1.5 mm, inner diameter 4.0 mm, outer diameter 6.0 mm) and different lengths (6 to 30 mm) were designed to accommodate varying distances between implants (Fig 3).

After the surgery, the multiunit abutments were screwed onto the implants. The implant cylinders were tightened to the multiunit abutments (Fig 4a). If the height of the implant cylinders interfered with the patient closing fully into occlusion, the cylinders were shortened accordingly. The interimplant distance was measured and connecting bars of optimal lengths were

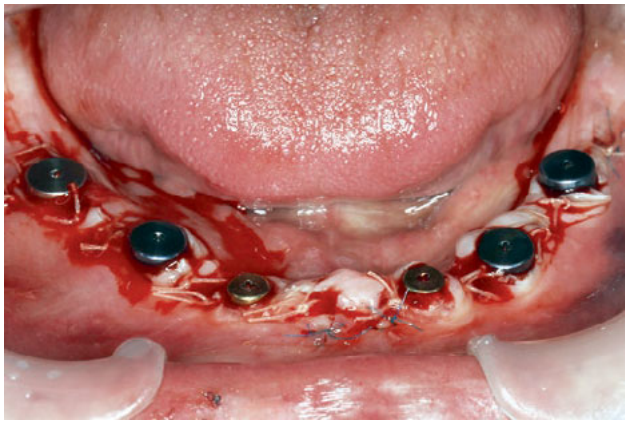

Fig 2 Edentulous mandible with six implants.

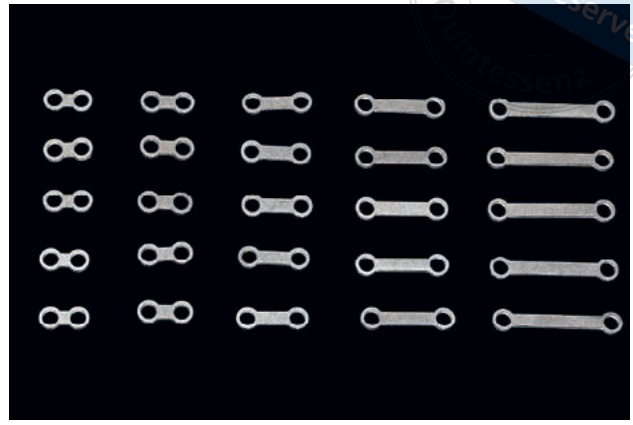

Fig 3 Prefabricated rigid connecting bars of various lengths.

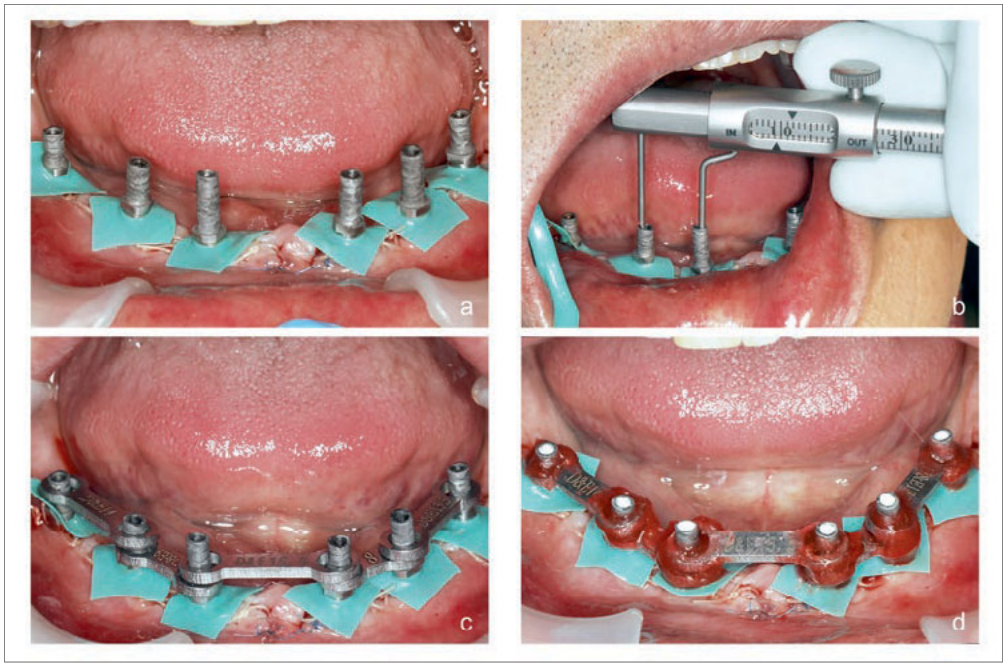

Fig 4 **(a)** Multiunit abutments and implant cylinders screwed into the implants; **(b)** measurement of the inter-abutment distance; **(c)** connecting bars of optimal lengths placed on the implant cylinders; **(d)** intraoral splinting of rigid connecting bars with a small amount of autopolymerising acrylic resin.

selected (Figs 4b and c). A small amount of autopolymerising acrylic resin (Pattern Resin; GC Corporation, Tokyo, Japan) was applied to connect the bars to the implant cylinders using a powder/liquid brush application technique (Fig 4d).

Light viscosity impression material (Express; 3M, Saint Paul, MN, USA) was injected underneath the splinting structure, and medium viscosity impression material (Express; 3M) was dispensed into the patient's mouth to ensure adequate exposure of all the screw channels (Fig 5a). Simutaneously, the patient's mandible was guided to the occlusal vertical dimension and occlusal registration was recorded (Fig 5b) at the same visit. Thereafter, the implant cylinders were unscrewed so that the splinted bars remained in the impression when it was removed (Fig 5c). Implant analogs were inserted into the impression and gingival mask material was injected around them (Fig 5d). The implant analogs were splinted with connecting bars and mounted on the articulator (Fig 6).

The interim prosthesis was fabricated using the conventional acrylic resin processing technique. The connecting bars were embedded as a reinforcing framework in the prosthesis (Fig 7). Three hours after surgery, the interim prosthesis was screwed to the implants with a torque of 15 Ncm (Fig 8a). A panoramic radiograph was taken to assess the passive fit of the prosthesis (Fig 8b). Denture base fracture was observed around 2 months

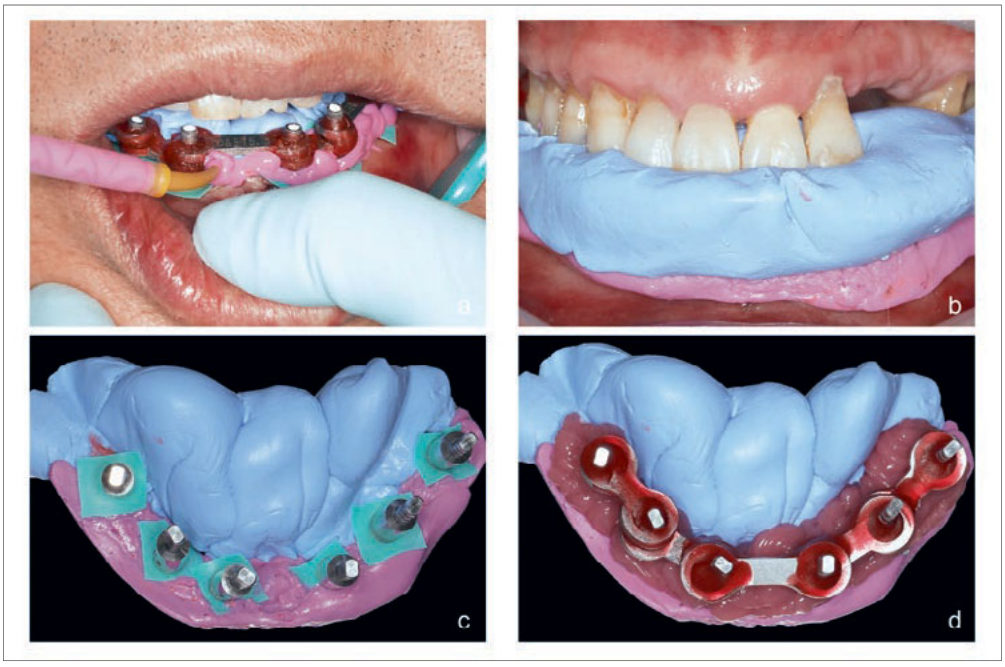

Fig 5 **(a)** Injection of impression material with no impression tray; **(b)** occlusal record of the patient over the splinting structure; **(c)** intaglio surface of the definitive impression with implant analogs inserted; **(d)** impression with a gingival mask and implant analogs splinted with rigid connecting bars.

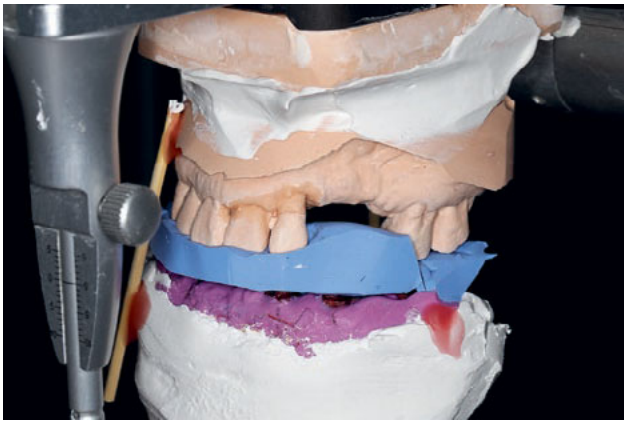

Fig 6 Gypsum casts on the articulator.

Fig 7 **(a)** Interim prosthesis with connecting bars embedded; **(b)** interim fixed implant-supported full-arch prosthesis.

after immediate restoration. The fracture occurred at the posterior edge of the denture rather than where the rigid connecting bars were embedded (Fig 9). The restoration was repaired and the patient was recalled 6 months after surgery to receive a final prosthesis. A new maxillary removable partial denture and mandibular metal-ceramic fixed full-arch prosthesis were fabricated and delivered (Fig 10).

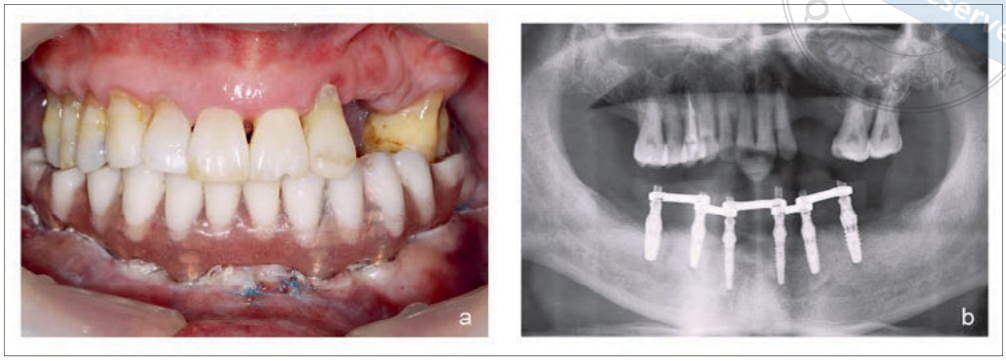

Fig 8 **(a)** Interim prosthesis in place immediately after implant surgery; **(b)** panoramic radiograph after immediate loading.

Fig 9 Denture base fracture of the interim prosthesis.

Fig 10 **(a)** Final prosthesis delivered 6 months after implant surgery; **(b)** panoramic radiograph after final prosthesis delivery.

Discussion

The present article describes a technique for fabricating interim, immediately loaded implant-supported full-arch prostheses with prefabricated rigid connecting bars. The main advantage of the technique is that it can simplify the process and improve the efficiency of the workflow. The prefabricated bars eliminate the time required for the fabrication of custom splinting structures and working cast preparation in the laboratory, reducing the waiting time and facilitating finishing of interim prostheses. In addition, edentulous patients who have lost occlusal contact points of natural teeth need their interocclusal relationship to be recorded prior to fabrication of the prosthesis. The technique described in this article makes it possible to take impressions and make occlusal records simultaneously, which can avoid the need to fabricate resin record bases in the laboratory and lower the risk of postoperative wound swelling. Compared with the conventional method, this technique can reduce chair time by around 1.5 hours. Time can be saved in impression taking, occlusal registration and pouring plaster models.

Acrylic resin polymerisation shrinkage has been considered a critical factor when taking impressions for multiple implants, especially for four or more implants

per dental arch[9-10]. Previous reports have proposed some innovative methods to solve this problem, such as the use of 3D printed splints and digital impression methods, the accuracy of which needs to be verified further[7,8,11]. In our proposed technique, the prefabricated bars minimise the mass of acrylic resin used and provide a homogeneous space between the joints, which can effectively prevent the impression error caused by polymerisation shrinkage.

Sufficient attention must be paid to the early complications that can occur in cases of immediate loading in edentulous full-arch restorations. Specifically, mechanical complications include prosthesis loosening, screw or abutment fracture, artificial tooth fracture and resin base fracture. Denture base fracture has been reported as a main complication during the time in function of immediate prostheses. Shen et al[12] reported that 28.1% of immediate prostheses fractured in 114 patients during 6 months of function. This type of complication was significantly related to bruxism, cantilever, the material used and maxillary rehabilitation[13]. Some studies utilised cast or milled metal bars and a CAD/CAM framework to reinforce the acrylic resin[6,14]; however, these techniques require extra time and make it difficult to complete the prosthesis within 24 hours. In contrast, the prefabricated bars can be used directly as a reinforcing framework in the poly(methyl methacrylate) denture base, which is a more economical and convenient method for reinforcement.

Immediate loading of an interim prosthesis increases the risk of misfit as well as adverse movement of the entire structure. The use of intermediate multiunit abutments allows the clinician to obtain an absolute passive fit of screw-retained full-arch prostheses, even in the presence of several angled implants. In addition, previous studies have shown that repeated screwing/unscrewing of the superstructure can result in permanent failure of the hemidesmosomal soft tissue connection around the implant[15]. Placement of intermediate abutments makes it possible to perform further restorative operations at the abutment level to protect the peri-implant soft tissues from damage and maintain bone tissue stability.

The present case report has several limitations. On one hand, taking an impression without using the tray causes the impression material to lose the support of the rigid tray, which may cause the material to become deformed when pouring a plaster model or mounting the articulator. On the other hand, this paper is susceptible to bias due to the weak strength of medical evidence as it is an individual case report. Well-designed randomised controlled trials with larger sample sizes are therefore necessary to further validate this method in the future.

Conclusion

This article presents an efficient technique for fabricating interim, immediately loaded implant-supported full-arch prostheses with prefabricated rigid connecting bars. The reduction of laboratory and chair time and the elimination of the possibility of errors are important contributing factors to achieving more predictable and successful prosthesis for both clinicians and patients.

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Conflicts of interest

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

Author contribution

Dr Yi Man TANG contributed to the data analysis and drafted the manuscript; Dr Hua Jie YU contributed to the data acquisition and interpretation; Prof Li Xin QIU and Dr Juan WANG contributed to the design of the case and the conduction of surgical and restoration procedures and critically revised the manuscript.

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