A Method to Improve Passive Fit of Frameworks on Implant-Supported Prostheses: An In Vivo Study

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Purpose: A die stone jig was evaluated as to its ability to clinically verify the position of the abutment replicas on the master cast. ***Materials and Methods:*** A clinical evaluation was made on 58 edentulous arches necessitating rehabilitation with fixed partial dentures. Any broken jigs detected were replaced with a new set of jigs and clinically retested. Data were statistically confirmed. ***Results:*** Fifty-five percent of the 58 jigs broke, with a 95% confidence interval (CI) of 42.5 to 67.3; after replacement, there were no breakages (95% CI: 0 to 6.2). ***Conclusions:*** The jig detected misfits in clinical trials, according to the parameters defined in the literature. *Int J Prosthodont 2013;26:577–579. doi: 10.11607/ijp.3326*

Various methods to verify the position of implants between the master cast and the oral cavity are described in the literature; however, some are difficult to construct and others are expensive and make use of metal, resin, and plastic materials that, at times, hamper the desired precision.[1,2]

This study aimed to assess a die stone jig's ability to clinically verify the position of the abutment replicas on the master cast, so as to avoid framework misfit before construction.[3]

Materials and Methods

The die stone jig (8-mm high and 3-mm thick) was able to detect vertical misfits with values above 30 µm, horizontal misfits above 100 µm, and angular misfits of less than one degree. It was clinically tested on 58 patients (23 men and 35 women, mean age ± SD: 65.9 ± 9.5 years) requiring in the edentulous maxilla (38) or mandible (20) a fixed partial denture (four or six implants) on a titanium framework constructed by the computer numerically controlled (CNC) milling technique (275 total implants: 185 maxillary and 90 mandibular).

Seven operators, with varying degrees of expertise in implant prostheses, followed the same protocol: the impression was taken after 4/10 months from implant insertion on a multiunit abutment. The master casts were made with a low-expansion, resin-fortified die stone.

The technician constructed 38 maxillary and 20 mandible jigs (first jigs). Each jig was manually screwed onto the oral abutments. If the jig was intact, the technician proceeded with the framework construction, while, in the case of fractures, a very small quantity of pattern composite resin was used to repair the damage (Figs 1 and 2). Once the hardening process was completed, the jig was gently removed.

Any replicas that did not match the jig were removed from the cast with a bur drill. They were then screwed back onto the jig (Fig 3) and re-embedded in the master cast using a small quantity of low-expansion die stone. On the basis of this new position, the technician constructed a second jig that was then tested in the oral cavity for misfits.

Statistical analysis was carried out by Confidence Interval Analysis software, version 2.1.2 (BMJ), the Student-Fischer *t* test, and a multivariate logistic regression model analysis (STATA v 9.0). A finite element study was carried out to simulate the structural behavior of the implant configurations presented in the study.

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Fig 1 The first jig is screwed onto the implants; note the misfit and breakage in two places.

Fig 2 A very small quantity of composite resin bonds the fractured pieces, registering the new position in the oral cavity.

Fig 3 Any replicas that do not match the new position of the jig are removed from the cast. The replicas are re-screwed onto the jig and then re-embedded with low-expansion die stone.

Results

On the first attempt, 55% of the jigs had at least one fracture, ie, a total of 32 jigs: 22 in the maxilla and 10 in the mandible, with a 95% confidence interval (CI) of 42.5 to 67.3. After having carried out corrections, there were no breakages on the second jigs, a 100% success rate with a 95% CI of 0 to 6.2. The mathematical models demonstrated that there were no variations in the tension state in the presence of different implant configurations such as loads and/or bone quality.

Discussion

The dimensions of the die stone jig were examined in a previous in vitro study[4] to reach the best compromise between sensitivity and aptitude of handling without accidental fractures in clinical use.

Table 1 Fracture Probability*

	OR	95% CI		*P*
Implants (n)				
4	1			
6	1.539	0.513	4.612	.442
Bone quality				
> 2	1			
≤ 2	1.868	0.566	6.164	.305
Arch				
Maxilla	1			
Mandible	0.696	0.227	2.132	.526
Age (y)				
< 65	1			.589
≥ 65	0.738	0.245	2.219	
Sex				
F	1			
M	1.125	0.374	3.387	.834
Edentulism time				
≤ 6 mo	1			
> 6 mo	1.672	0.558	5.005	.359
Operator				
Operator 1	1			
Other	2.901	0.803	10.478	.104

OR = odds ratio; CI = confidence interval.
The fracture probability ratio increases for more than 4 implants (OR > 1) and bone quality ≤ 2 (Albrektsson and Zarb criteria), with the same bone quality and type of arch. The jig fracture probability ratio decreases if the arch is in the mandible. None of the effects described were statistically significant (P > of .05). The jig fracture probability ratio, whatever the set of fixed variables, was not affected by sex, but there was an inversely related increase with the operator's experience, an increase if the edentulous period was > 6 months and a decrease if patients were > 60 years of age. The effects were not statistically significant (P > of .05).

There were no fractures in the second set of jigs tested. This datum was interpreted as an acceptable fit according to the literature.[5] Operator experience did not influence the outcome. The lack of fracturing in the second set of jigs is statistically characterized by a very low CI of 0 to 6.2, evidencing the high significance of the result (Table 1).

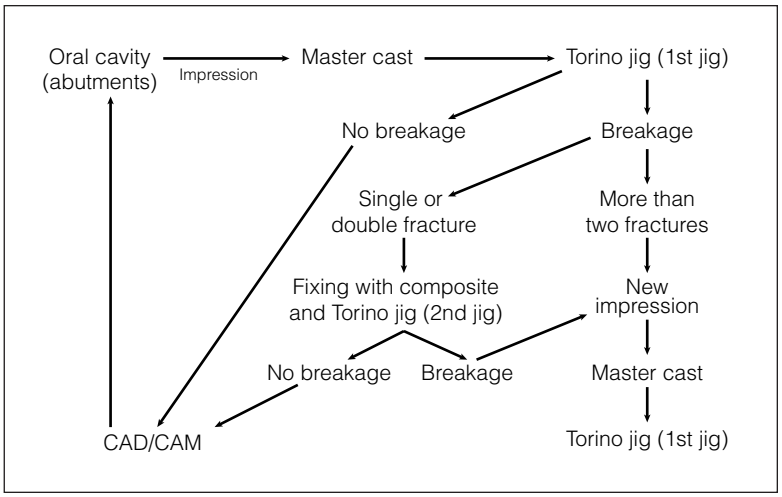

Fig 4 Flowchart for clinical practice. CAD/CAM = computer-aided design/computer-assisted manufacture.

In the presence of small misfits, jig fracture is always rectified by employing a small amount of resin to bond the fractured parts without creating any contraction. In fact, the frameworks obtained with CNC milling procedures, after the jig-guided corrections (32 on a total of 58), fit perfectly onto the implants in the oral cavity.

The origin of the fault may be in the impression or technical services or both. The jig can find and correct it, within the range of misfits described.

On the basis of the data, the authors propose a clinical protocol illustrated in Fig 4.

Conclusions

The easy-to-make, user-friendly, and cost-effective die stone jig is useful to avoid wasting labor on CNC milled precision and chair time. No fractures, loosening of the frameworks, radiographic translucency, or implant mobility were observed at the annual check-up. The same trend continued throughout the 3- to 7-year follow-up.

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