A RFA (Resonance Frequency Analysis) CLINICAL STUDY OF IMMEDIATELY LOADED AND DELAYED LOADED SLA-ITI IMPLANTS

Nedir Rabah [1,2], Bischof Mark [1,2], Beyer Stephan [1]
Szmukler-Moncler Serge [2], Samson Jacky [2]

[1] CdR, Clinique Dentaire SA,
Rue du Collège 3, 1800 Vevey, Switzerland
[2] Department of Oral Surgery, School of Dental Medicine,
University of Geneva, Geneva, Switzerland

Université de Genève

INTRODUCTION

Resonance Frequency Analysis (RFA) has been recently introduced as a novel method to get an objective measure of implant stability (fig 1). It is aimed to replace the Periostest (Siemens AG, Bensheim, D) device introduced in 1986 by Schulte et al., extensively used during the last 10 years. Recently, an ISQ (Implant Stability Quotient) scale has been proposed in the 1-100 range. The method has been suggested to be useful at implant placement, to decide if an implant can be early loaded, immediately loaded or requires a standard delayed loading period of up to 6-8 months. It might also be used as a decision tool at the 2nd-stage for submerged implants and at the prosthetic step for non-submerged implants to start or not the prosthetic procedure. Most of the RFA data have been obtained for Brånemark implants. In this context, a prospective clinical investigation was set-up to : 1) generate ISQ data with ITI implants, 2) measure implant stability after 3 months of healing at delayed (DL) and immediately (IL) loaded implants, 3) to monitor the osseointegration of IL implants with short-span bridges (2-6 units).

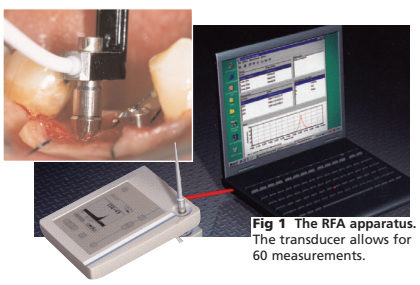

Fig 1 The RFA apparatus. The transducer allows for 60 measurements.

MATERIAL & METHODS

The IL and DL groups involved respectively 11 patients/37 implants and 15 patients/42 implants, the mean age was respectively 57.1 y and 57.5 y (fig 2). Implants of Ø 4.1 and Ø 4.8 mm, and 8-13 mm long (fig 3-4) were placed in the mandible (IL : 27.8 %, DL : 31.0 %) and in the maxilla (IL : 62.2 %, DL : 69.0%). Most of them supported short span bridges (DL : 83.8 %, IL : 64.8 %). The ISQ was recorded at implant placement (ISQi) and 12-14 weeks later (ISQf), before delivering the definitive prosthesis. The ISQi was recorded according to jaw, implant Ø, implant length and bone quality (fig 5-7). ISQ variation during healing (ΔISQ) was recorded at the DL and IL implants. The Kruskal-Wallis or the Mann-Whitney U test was applied accordingly to determine the factors affecting the ISQi and the ΔISQ.

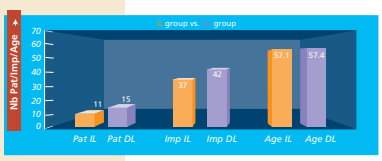

Fig 2 IL and DL groups description. The groups were similar in age.

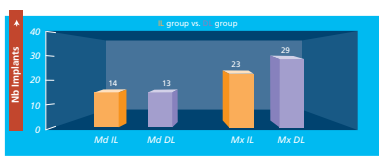

Fig 3 Implant distribution according to site. Most implants were placed in the maxilla.

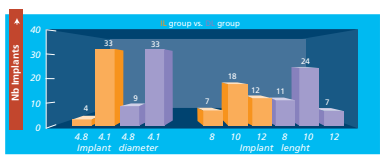

Fig 4 Implant diameter and length. More 12 mm were placed in the IL group.

RESULTS

The ISQi values at implant placement according to jaw, bone type, implant diameter and implant length are given in figures 5-7. The ISQi was not influenced by the jaw (p=0.063), the bone type (p=0.143), the implant Ø (p=0.105) but by implant length (p=0.035). The ΔISQ at the IL and DL groups were respectively 3.1 ± 5.5 and 3.5 ± 5.0, they were not different (p=0.190). Examples of the ISQ evolution with time are given. Figure 8 shows the ISQ measured in the IL group for implants placed in the mandible and in the maxilla with low ISQi (40-45) and high ISQi (55-60). Figure 9 shows the same data for the DL group.

No difference in ΔISQ was found between the IL and DL groups (fig 10). The implants were pooled and analysed according to the jaw. The ΔISQ increased more in the mandible than in the maxilla, respectively 5.6 ± 4.2 and 2.2 ± 4.4 (fig 11), the difference was significant (p=0.002). Fig 12 and 16 show examples of IL treated cases.

One IL implant became mobile after 4 weeks, the ISQ was 53 after placement, it was 46 when clinical mobility was detected (fig 13 and 14). No further failure was recorded, the cumulative success rate of the IL implants was 97.30 % (fig 15).

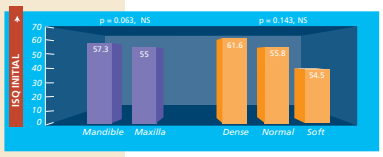

Fig 5 ISQ values at placement : Effect of jaw and of bone type. No difference was found between the mandible and the maxilla. No difference was found between dense and soft bone.

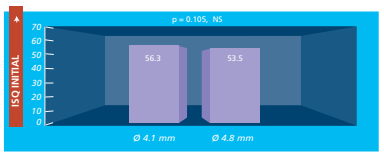

Fig 6 ISQ values at placement : Effect of diameter. No difference was found between standard and large diameters.

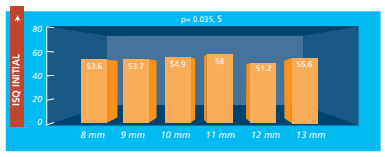

Fig 7 ISQ values at placement : Effect of implant length. Length was found to be a parameter affecting the ISQ value. Nevertheless, no clear correlation between the ISQi and implant length was found.

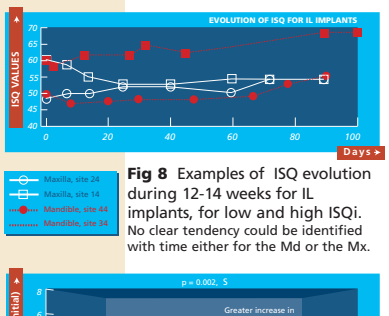

Fig 8 Examples of ISQ evolution during 12-14 weeks for IL implants, for low and high ISQi. No clear tendency could be identified with time either for the Md or the Mx.

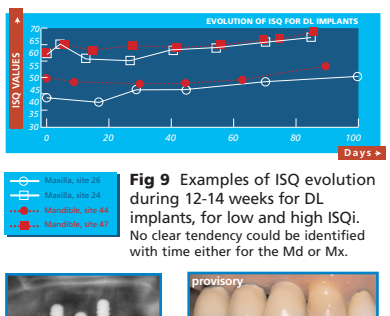

Fig 9 Examples of ISQ evolution during 12-14 weeks for DL implants, for low and high ISQi. No clear tendency could be identified with time either for the Md or Mx.

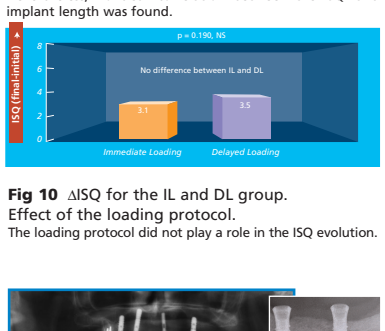

Fig 10 ΔISQ for the IL and DL group. Effect of the loading protocol. The loading protocol did not play a role in the ISQ evolution.

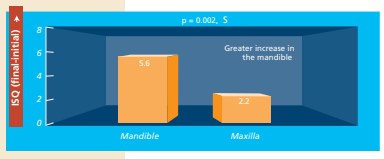

Fig 11 ΔISQ for the pooled implants. Effect of jaw. In the mandible, the ISQ increased more than in the maxilla.

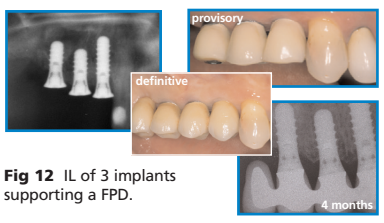

Fig 12 IL of 3 implants supporting a FPD.

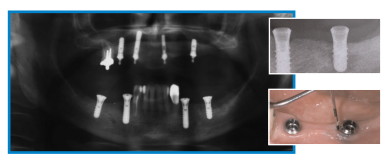

Fig 13 IL of 2 implants supporting a FPD in the mandible. After 4 weeks the implant 36 displayed a PD of 6 mm and was mobile.

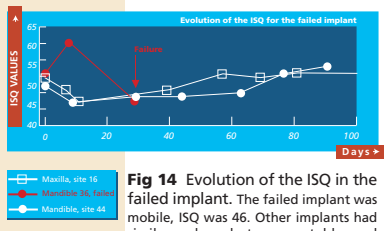

Fig 14 Evolution of the ISQ in the failed implant. The failed implant was mobile, ISQ was 46. Other implants had similar values but were stable and osseointegrated.

LIFE TABLE ANALYSIS

Time	Implants at risk	Failures	Success rate on period	Cumulative success rate
0-3 m	37	1	97.30%	97.30%
3-6 m	36	0	100%	97.30%
6-9 m	36	0	100%	97.30%
9-12 m	36	0	100%	97.30%
12-15 m	24	0	100%	97.30%

Fig 15 15-month life table analysis of IL implants. One failure (1/37) happened during the first 3 months. No further failure was recorded.

Fig 16 IL of 3 implants placed in a fresh extraction socket. Note the gingival tissue healing after 1 week.

DISCUSSION & CONCLUSIONS

These preliminary data show that IL short span bridges might be predictable with ITI SLA implants since 1 out 37 failed. As in other IL reports, the failure occurred during the first 3 months.

The ISQi was affected neither by jaw, bone quality or implant diameter but by implant length only. However, no relevant correlation between implant length and ISQ could be found. For Brånemark implants, implant inserted in the mandible have usually higher ISQi than in the maxilla because of the distinct bone quality. This was not the case for the ITI implants and therefore, the present data are surprising. If confirmed, this would suggest that the RFA method is not very sensitive for ITI implants, despite the fact that the measured ISQ were in the same range as the ISQs of Brånemark implants.

Surprisingly, the ΔISQ was higher in the mandible than in the maxilla. With Brånemark implants, the higher initial ISQs remain stable or tend to decrease with time and the lower initial ISQs tend to increase with time. The present data did not show such a tendency.
The ΔISQ of the IL and DL implants were not statistically different after 3 months when osseointegration is achieved. It might mean that the healing patterns are similar for both implant groups although they are submitted to distinct biomechanical environments.

The ISQ of the mobile implant was 46, however similar values have been measured at stable implants. This suggests that the RFA method does not measure the osseointegration of an implant, it seems to be a relative value only, similar to the Periostest values. In addition, as cemented prosthesis are largely used on ITI implants, the RFA method cannot be routinely employed to monitor implant stability after prosthetic rehabilitation. The advantage of the RFA method over other methods like the Periostest needs still to be demonstrated. Each transducer costs 600 euros and allows for 60 measurements only, thus making the method expensive.

In conclusion, immediately loaded short-span bridges of 2-6 units supported by SLA ITI implants can achieve high success rates in the mandible and in the maxilla.

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