Immediate restoration in the digital workflow

Part II: Results and discussion

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Part I

The success of immediately placed implants has been investigated in various studies with encouraging results already. But what is rather simple in the anterior mandible needs more attention when it comes to the anterior maxilla. Here, clinicians are oftentimes concerned not only about achieving adequate implant stability, but also about fulfilling patients' desires for aesthetic results that resemble the natural dentition. To shorten procedures and eliminate intermediate prosthetic steps, digital technologies were developed that allow the intraoral scanning of models and attachments with a high degree of precision and reproducibility.

The article demonstrates the reliability of the single-session protocol using digital methods for scanning and producing crowns complemented with platform switching and evaluates the peri-implant soft-tissue seal. In part I of the article (published in *implants* 2/17), the authors described materials and methods used in an experiment with animals and in the treatment of humans. In part II of the article, the results are presented and discussed.

Tab. 1: Friedman test of ISQ analysis and measurements at initial day. Results as mean and medians. No significant differences with $p < 0.05$ were found.

ISQ value	Insertion		p value
	Mean ± Sd	Median	
BioHPP abutment	74.46 ± 4.55	74.46	0.16
Titanium abutment	74.19 ± 4.29	74.19	0.23

Table 1

Tab. 2: Friedman test of BIC values. Comparison between titanium and hybrid PEEK-Ti abutments. Follow-up eight weeks after implant placement. Data shows mean, Sd and medians. No significant differences with $p < 0.05$ were found.

BIC (%)	Titanium	PEEK	p value
Mean ± Sd	61.29 ± 1.45	62.52 ± 4.63	0.32
Median	61.29	62.52	

Table 2

Rationale for immediate restoration

Research has shown that, for two-stage implants, marginal bone loss occurs primarily during the first year following placement and that this has mainly been attributed to the establishment of biologic width adjacent to the implant.[19] Some studies have shown that bone remodelling can be biologically ascribed to bacterial colonisation of the microleakage present in a two-stage implant system and subsequent inflammation.[20] The crestal bone loss around implants has both horizontal and vertical components. Following abutment connection, crestal bone has been shown to recede from the implant/abutment junction microgap by 1.3 to 1.4 mm, measured horizontally.[21]

Animal study

Immediate implant placement and restoration minimise the harmful contamination of the peri-implant biological space and the resultant bone resorption. Immediate loading requires that certain prerequisites are met. The best way to objectively quantify the feasibility of immediate loading clinically is to analyse implant stability either by measuring the insertion torque, recommended at above 30 Ncm, or using the Osstell Mentor ultrasonic stability measuring device that returns ISQ values, which if above 65–70 allow us to load immediately with some confidence (Tab. 1).

Changes in the peri-implant tissue can be quantified by histomorphometry and histological evaluation in experimental studies (Tabs. 2 & 3). The radiological results of the animal experiments are documented in Figures 1a & b and Table 4. The histological connection between the soft tissue and the SKY elegance abutment is tight. In combination with platform switching, this produces a high level of bone stability at the implant collar (Figs. 2a & b).

		Titanium	PEEK	p value
PM-BC	Mean ± Sd	2.74 ± 0.41	3.11 ± 0.26 *	0.032
	Median	2.74	3.11	
PM-LC	Mean ± Sd	2.91 ± 0.03	3.71 ± 0.18 *	0.008
	Median	2.91	3.71	
PM buccal-IS	Mean ± Sd	2.35 ± 0.87	2.95 ± 0.53 *	0.015
	Median	2.35	2.95	
PM lingual-IS	Mean ± Sd	2.65 ± 0.43	3.57 ± 0.38 *	0.003
	Median	2.65	3.57	
IS-BC	Mean ± Sd	2.04 ± 0.11 *	1.53 ± 0.21	0.011
	Median	2.04	1.53	
IS-LC	Mean ± Sd	1.93 ± 0.14 *	1.41 ± 0.19	0.029
	Median	1.93	1.41	

Table 3

Linear measurements in millimetre: PM-BC: distance from the peri-implant mucosa to the buccal bone crest; PM-LC: distance from the peri-implant mucosa to the lingual bone crest; PM buccal-IS: distance from peri-implant mucosa to the implant shoulder in the buccal aspect; PM lingual-IS: distance from peri-implant mucosa to the implant shoulder in the lingual aspect; IS-BC: distance from the top of the implant shoulder to the first bone-to-implant contact in the buccal aspect; IS-LC: distance from the top of the implant shoulder to the lingual bone crest. Values as mean ± Sd and median.

Tab. 3: Non-parametric Friedman test to related samples. (*) Significant differences with $p < 0.05$.

Rationale for platform switching

The switch in implant platform diameter prevents apical migration of the epithelial attachment and soft-tissue ingrowth at the top of the platform by reducing bacterial migration and, consequently, of soft-tissue ingrowth and peri-implant bone loss. Marginal bone loss is drastically reduced and the objective criteria for peri-implant inflammation are greatly improved.[22]

Human study

Table 5 lists clinical parameters from human studies at one, three and five months. Figures 3a to h show radiological findings at one, three and five months. Figures 4a and b show the customisation of a SKY elegance abutment.

Rationale for single-stage treatments

Successive insertions and reconnections when restoring an implant according to conventional protocols provoke bacterial invasion and colonisation of the biological space and mark the onset of marginal bone loss. Offering treatment in a single session provides the biological benefits described and saves time and money, increasing patient satisfaction.[23]

Intraoral scanning

Fabricating a CEREC crown requires a step prior to intraoral scanning, namely the adaptation of the prosthetic support. The SKY elegance abutment can be cut and customised in the mouth, more or less like dentin, which means a reduction in time and cost. Also required are a delicate surface polish and preparation of the profiles to be recognised by the intraoral scanner. The restoration margins should be well-defined and prepared to the gingival or subgingival level.[24,25] The SKY elegance abutment anatomy allows to create a proper emergency profile that can be customised for

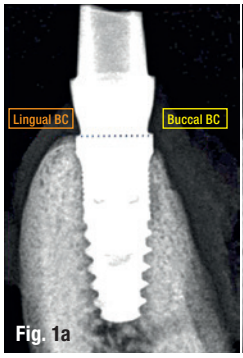

Fig. 1a

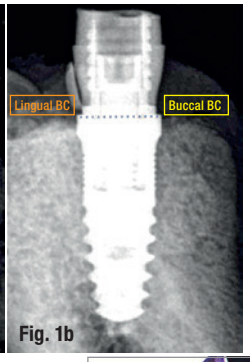

Fig. 1b

Figs. 1a & b: Radiological analysis. Comparison between a titanium abutment **(a)** and a SKY elegance abutment **(b)**.

		Titanium	PEEK	p value
Buccal bone	Mean ± Sd	1.96 ± 0.21 *	1.43 ± 0.11	0.013
	Median	1.96	1.43	
Lingual bone	Mean ± Sd	1.78 ± 0.33 *	1.28 ± 0.43	0.031
	Median	1.78	1.28	

Table 4

Tab. 4: Radiological analysis of bone first contact distance to the implant shoulder. Values as mean ± Sd and median. Non-parametric Friedman test analysis. (*) Significant differences with $p < 0.05$.

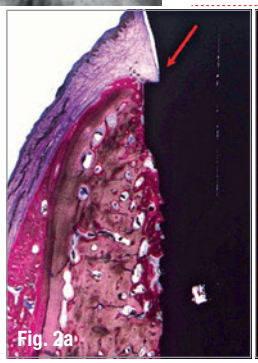
Fig. 2a


Fig. 2b

Figs. 2a & b: Histological analysis of the SKY elegance abutment. Detail of platform switching and connective-tissue insertion over platform. Connective tissue at four weeks **(a)**. Connective tissue at eight weeks **(b)**.

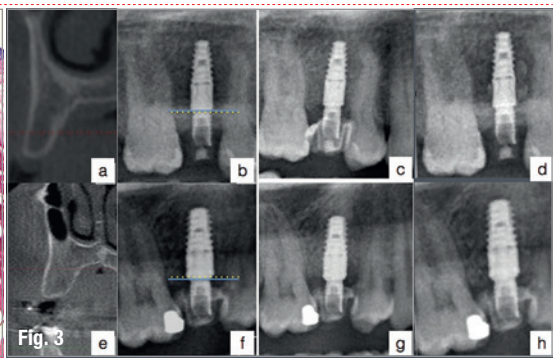

Fig. 3

Figs. 3a–h: Radiological analysis. Preoperative **(a, e)**, at one month **(b, f)**, at three months **(c, g)**, and at five months **(d, h)**.

each patient (Fig. 5). The next step is to obtain relative isolation, with any hint of moisture removed, to ensure a good intraoral impression. The savings in terms of time and money are evident, as is the increase in patient comfort.

Fabricating a CEREC crown

The choice of restorative material to use on an implant requires familiarity with the way masticatory forces are transmitted via the crown and abutment to the bone-to-implant contact area. Biomimetics is the study of the materials that allow us to adapt prosthetic elements to their intended proper function, based on similarity to the receiving environment.[26] Knowing how forces are transmitted is essential to avoid loads that can lead to bone loss or implant failure.

The SKY elegance is a hybrid abutment with a titanium base and a ceramically reinforced PEEK body, so the transmission of forces from the crown to the

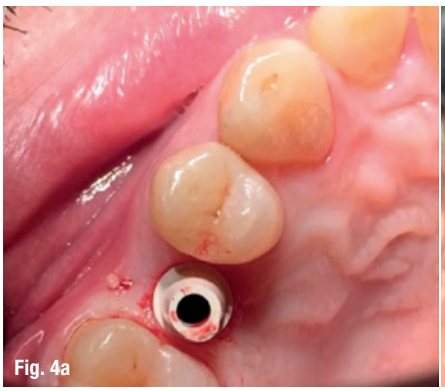
Fig. 4a


Fig. 4b

Figs. 4a & b: Customisation of a SKY elegance abutment.

		1 month	3 months	5 months	p value
First bone contact to platform (mm)	Mean ± Sd	0.50 ± 0.41	1.07 ± 1.12	1.17 ± 0.87	0.044
ISQ value (%)		68.10 ± 4.93	69.34 ± 1.22	71.43 ± 3.01	0.12
Bleeding on probing (0–1)		0.21 ± 0.01	0.16 ± 0.05	0.06 ± 0.02	0.014
Insertion length (mm)		3.64 ± 1.02	4.19 ± 1.05	4.11 ± 1.02	0.029

Table 5

Tab. 5: Human study, values as mean ± Sd. Non-parametric Friedman test. Values of bleeding on probing (0 = no bleeding on probing and 1 = bleeding on probing).

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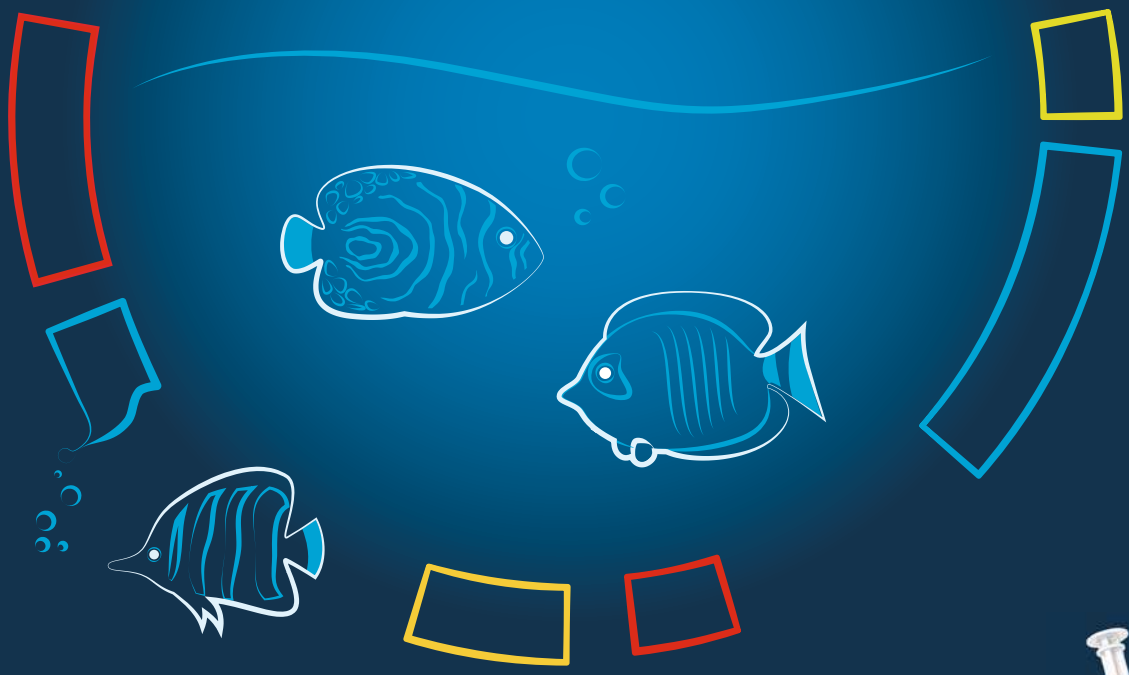

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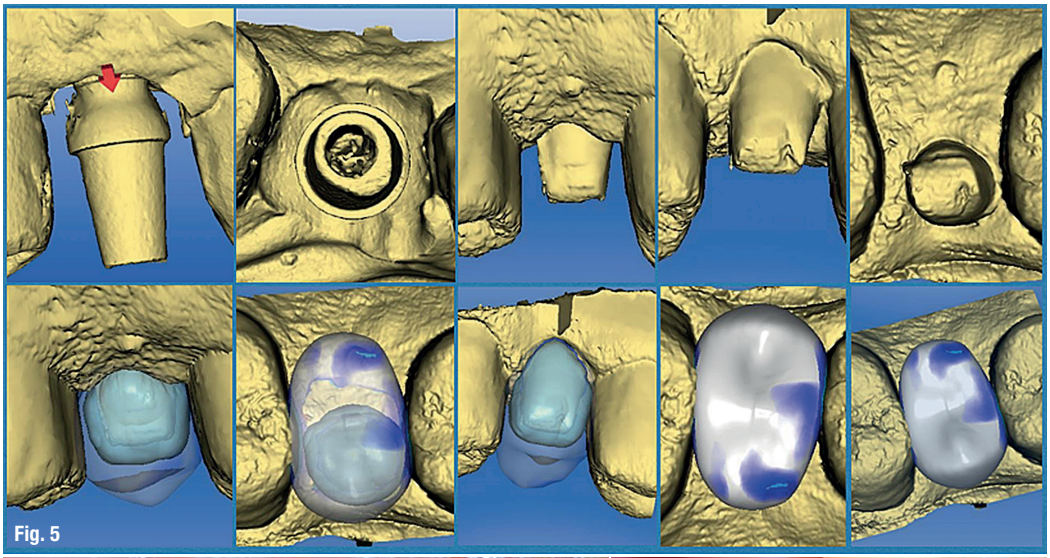

Fig. 5: Customising the SKY elegance abutment and crown design with CEREC.
Fig. 6: Final restoration at the day of surgery **(a)**. Detail of soft-tissue attachment **(b)**.

implant proceeds gradually and progressively. This helps avoid crown fractures due to internal or external tension between a ceramic crown and an all-ceramic abutment.

Using a hybrid abutment approach, there is a choice of resin or ceramic base materials, from feldspar ceramics to ceramics with a silicate base. This still leaves the interface to consider; here, the crown is best connected to the abutment using a resin-based composite cement that facilitates the gradual transmission of forces; also, these cements are more stable biomechanically than ionomer cements or derivatives (Figs. 6a & b).

Conclusion

The establishment of a stable peri-implant seal to maintain gingival health around implant-supported restorations must be a primary objective of any implant treatment. The single-stage approach allows the establishment of an initial peri-implant soft-tissue attachment that will be preserved as the abutment is not removed; hence, no violation of the biologic space will occur, allowing for greater tissue stability and yielding better aesthetics and an improved bone and soft-tissue stability.

The integration of digital technology (CEREC) in the implant/restorative process shortens the treatment time and reduces the cost for the patient. The SKY elegance abutment helps treat patients with predictable results._

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Literature

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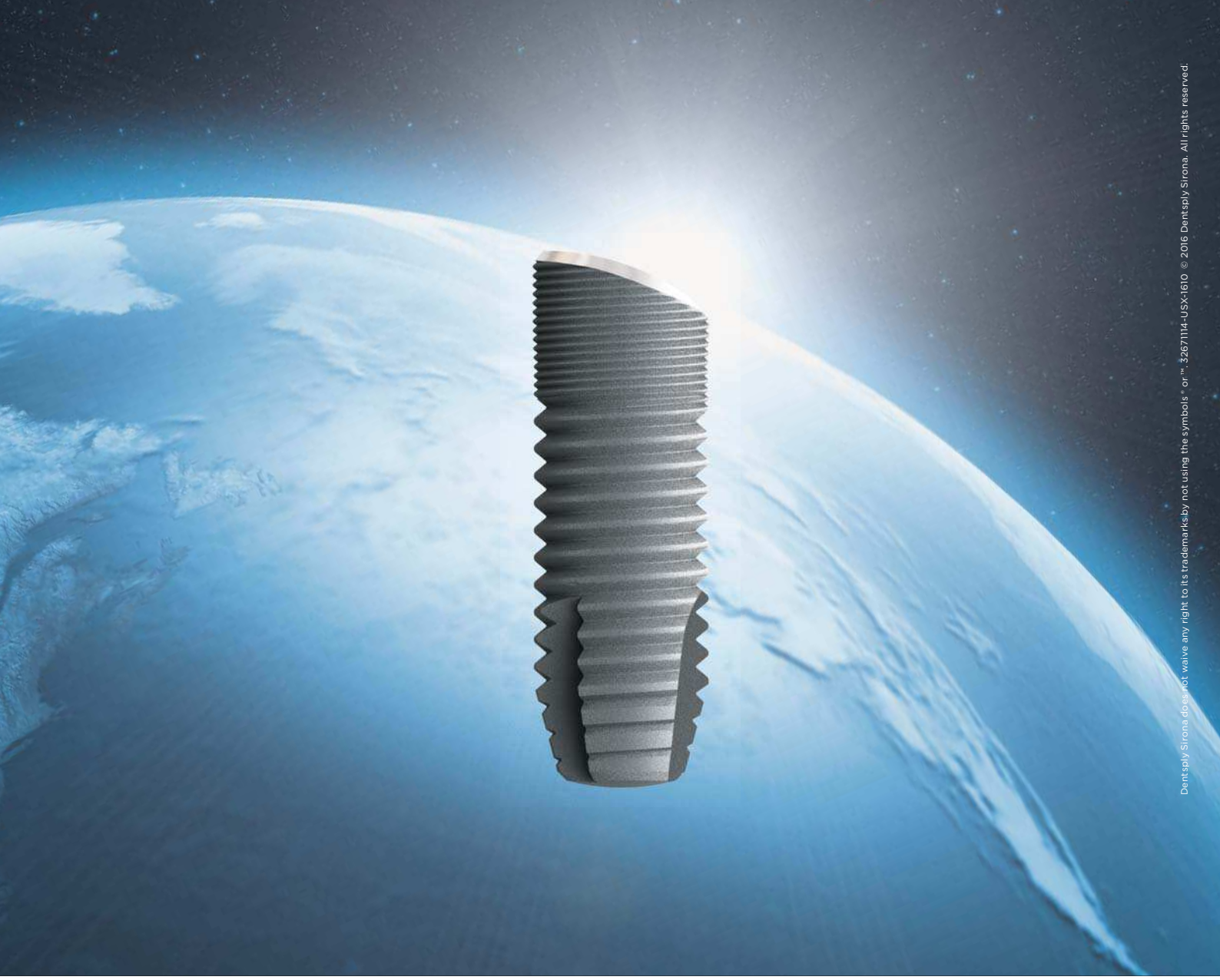

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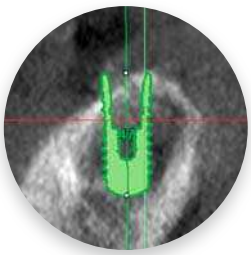

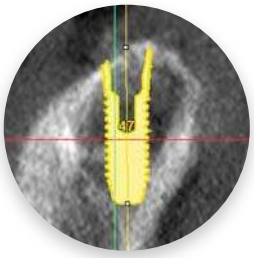

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