Early Osseointegration Attained by UV-Photo Treated Implant into Piezosurgery-Prepared Site Report II. Influences of Age and Gender

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Received: 13 Jan, 2021 | Accepted: 19 Jan, 2021 | Published: 25 Jan, 2021

Introduction

In our previous paper [1], synergistic effects of UV photofunctionalization on titanium implant surface and the piezosurgery-prepared site for implant placement were evaluated in terms of ISQ scales as a measure of placed implants' stability. From analyses on 35 clinic cases, it was found that UV surface alteration and enough blood supply by piezosurgery preparation exhibited synergistic effects on improvement of ISQ scales, making the assured loading timing, and even lowers the ISQ scale during the bone healing stage; they are still acceptable level for pursuing early loading. Since bone metabolism (or bone healing) is slow among aged patients and bone density level could differ between male and female patients, this difference could be furthermore emphasized among aged patients. Accordingly, in this paper, 40 additional cases are added to 35 cases (partially reported in previous paper [1]), so total 75 cases are subjected to analyze influences of age and gender on ISQ scales at implant placement and initial loading.

Gender plays a significant role in influencing bone density, which describes the quality of bone, and when age is considered, there are significant gender-related differences in bone mineral density [2]. Although man and woman possess a similar level of protein matrix per unit of segment volume, woman exhibits significantly less bone mineral to their skeletons [3], due to lower calcium content per skeleton and possible post-menopausal changes when they enter this age zone. Post-menopausal women are particularly vulnerable to osteoporosis because of the loss of estrogen associated with menopause. As estrogen decreases, there is an increase of cytokines (either directly or indirectly) that regulate osteoclasts [3]. Clinical...
osteoarthritis is more commonly observed in women [4,5]. As to implant survival rates between male and female patients, there appears to be no difference in implant success based on gender [6,7].

Lin G, et al. [8] used the multivariate generalized estimating equations (GEE) logistic regression method to identify risk factors related to both early and late implant loss on total of 18,199 patients received 30,959 dental implants. Multivariate analysis included age, gender, jaw, location, implant brands, implant length and diameter, bone augmentation procedures, and the number of implants placed per patient. It was reported that GEE showed that (i) general factors such as male gender, elderly patients, mandibular anterior location, bone augmentation and short implants were associated with implant loss and (ii) male patients aged older than 41 years, and mandibular anterior location were risk factors for early implant loss. In order to evaluate bone changes around endosseous implants in partially edentulous patients, 252 patients receiving total of 632 two-stage implants were subjected to assess the bone levels on orthopantomography immediately after surgery and after 36 months and marginal bone loss (MBL) was calculated from their difference [9]. It was mentioned that (i) MBL progressively increased with age in male patients but reached a peak already in the 50-60 years age group in the females and (ii) the overall MBL is consistent with the available literature. Site difference and patient age and gender appear to significantly affect MBL, representing important factors to be considered during implant placement.

Synergistic effects of UV photofunctionalization and piezosurgery were recognized in our previous study [1]. A specific aim of this retrospective study was to analyze dual effects under influences of age and gender variations in terms of the ISQ (implant stability quotient) scale as a measure of the implant stability. ISQ scale at implant placement and ISQ scale at early loading are measured and the differences between these scales could provide a promising indicator for healthy bone healing and the onset timing of loading (Table 1).

Materials and Methods

Materials

In the previous study, total 35 implants were placed, in which 33 implants were Osstem TS3 SA and 2 implants were Straumann Bone Level SLA. SA indicates that the implant surface was SAed (sand blasted with alumina particle, followed by an acid etching), while SLA means similarly that the surface of implants was subjected to sand blasted with large alumina grits, followed by acid etching. In this study, total 40 implants were placed, in which 31 Osstem implants (TS3, SS3) and 2 Shofu implants were SAed, and 7 Straumann implants (BLT, BL and TE) were SLAed. All implants were made of cpTi (commercially pure titanium) Grade IV. Diameter of all implants is larger than 4.0 mm and lengths are in a range from 7 to 8 mm.

UV photofunctionalization

For treating implant surfaces, the commercially available Thera BeamAffiny UV system was employed for 15 minutes for an automatic program of UV exposure, followed by the implant placement procedure.

Piezosurgery

Mectron Piezosurgery 2 system (Mectron SPA, Carasco, Italy) was utilized. The average operation time was about 15 minutes including exchanging times of 4 to 5 insert chips. The load that patients can feel is so light that this operation normally does not provide any unnecessary anxiety on patients. The implant placement was performed by routine procedure which should be a common practice regardless of surface conditions of implants and implant placement site preparation.

ISQ scale evaluation

The ISQ (implant stability quotient) is the value on a scale, indicating the level of stability and osseointegration in dental implants and is obtained using resonance frequency analysis (RFA) [10,11]. In this study, the Ostell ISQ system was used. The ISQ scales were measured at two directions, namely lingual and buccal sides. In table 2, a pair (for example, 80-80 for case No.1) indicates (80 measured at lingual side - 80 obtained at buccal side) ISQ scale data. ISQ scale measurements were conducted at immediate after implant placement (even before the suturing), designed as ISQ@I, and at the time of first loading, designed as ISQ@L, respectively. In addition, the changes in ISQ scales between ISQ@I and ISQ@L should indicate an overall stability of placed implants, the change rates (=ΔISQ/ISQ@I) × 100 in %) are also analyzed and proposed here to provide a useful implant stability indicator.

Results

For summary analysis purpose, data from table 1 was copied from our previous study [1]. The additional data sources are presented in table 2. For tables, the following notations are used:

1) ISQ@I: ISQ scale was measured at immediately after implant placement before suturing.
2) Load: after certain days (as marked under “Days bet. I/L), loading was conducted.
3) ISQ@L: ISQ scale was measured upon loading.
4) ΔISQ: the differences of ISQ scale between two readings: ΔISQ=ISQ@L-ISQ@I.
5) ΔISQ rate: for normalizing baseline, the ΔISQ rate was obtained by [ΔISQ/ISQ@I] × 100 (%).

Total 75 cases (35 cases in previous paper + 40 cases in this study) are presented in ages and gender as illustrated in figure 1, in which there are 21 male patients and 54 female patients. As to an age distribution, we divided into two groups: younger than 65 years old (total 37 patients=17 male+20 female) and aged over 65 years old (total 38=4 male+34 female). The reason for setting the age of 65 to separate two age groups is based on the fact that the age of 65 is one of commonly accepted age criterion for entering aging society. In this study, it was found that there was an equally divided age groups in younger and older than the 65-criterion.

Figure 2 illustrates ΔISQ rate in terms of days after implant placement till the initial loading. It appears to be that there are two distinctive groups in this graph: (i) a group which did not exhibit remarkable changes in ISQ scales, marked with dotted-red circle, and (ii) a group shows an increasing trend of ISQ scales during the healing period, marked with dotted-blue circle. These trends are normalized among gender difference and age difference.

Discussion

From figures 1 and 2, it seems to be that the needs from elderly women for implant treatments are more demanded. Their healing manner is also varied and clearly can be divided into two tendencies; one group showed remarkable increase in ISQ value during the bone healing period, and other trend exhibits no changes during an entire healing process. Relatively speaking, female patients younger than the 65-year-old criterion show an increment tendency in ISQ values within 2-month healing stage. When occlusion is loaded the placed implant, it is the bone to bear the occlusal force. The implant placed at mandibular jaw may be in contact with the dense bone on the

Citation: Miyazaki T, Yutani T, Murai N, Kawata A, Shimizu H, et al. (2021) Early Osseointegration Attained by UV-Photo Treated Implant into Piezosurgery-Prepared Site Report II. Influences of Age and Gender. Int J Dent Oral Health 7(2): dx.doi.org/10.16966/2378-7090.351
Table 1: Summary of obtained data in terms of loading date, implant dimension and location, ISQ at placement and loading date and ISQ at loading [1].

| No. | Implant 2014 | Loc | Size (mm) | ISQ@I | Load | ISQ@L | Days bet. I/L | ΔISQ | ΔISQ rate (%) | ISQ-A |
|-----|--------------|-----|-----------|-------|------|-------|--------------|------|--------------|-------|
| 1   | 03/14        | 45  | 4.5 × 7.0 | 04/28 | 77-77| 34    | 58           | 78-78(05/09) | |
| 2   | 03/27        | 44  | 4.0 × 10.0| 04/28 | 58-58| 34    | 58           | 78-78(05/09) | |
| 3   | 03/27        | 46  | 4.0 × 11.5| 06/24 | 58-59| 66    | 66           | 18-18(05/20) | |
| 4   | 03/27        | 46  | 4.5 × 8.5 | U     | 06/24| 77-77 | 67           | 10.4 |               |       |
| 5   | 03/28        | 45  | 4.5 × 8.5 | 06/12 | 75-71| 55    | 55           | 10.4 |               |       |
| 6   | 03/28        | 46  | 4.5 × 8.5 | 06/12 | 83-83| 66    | 66           | 10.4 |               |       |
| 7   | 03/29        | 44  | 4.0 × 10.0| 05/24 | 75-75| 57    | 57           | 10.4 |               |       |
| 8   | 03/29        | 46  | 5.0 × 10.0| 05/24 | 75-75| 57    | 57           | 10.4 |               |       |
| 9   | 04/03        | 26  | 5.0 × 8.5 | 05/30 | 70-69| 57    | 57           | 10.4 |               |       |
| 10  | 04/05        | 25  | 5.0 × 8.5 | 05/24 | 71-70| 49    | 49           | 10.4 |               |       |
| 11  | 04/05        | 22  | 3.5 × 10.0| 06/06 | 64-64| 62    | 62           | 10.4 |               |       |
| 12  | 04/11        | 21  | 4.0 × 10.0| 05/26 | 74-74| 55    | 55           | 10.4 |               |       |
| 13  | 04/11        | 44  | 4.5 × 8.5 | 05/13 | 75-75| 32    | 32           | 10.4 |               |       |
| 14  | 04/11        | 46  | 4.5 × 8.5 | 05/13 | 72-72| 32    | 32           | 10.4 |               |       |
| 15  | 04/17        | 46  | 4.5 × 8.5 | 05/24 | 75-75| 57    | 57           | 10.4 |               |       |
| 16  | 04/18        | 35  | 4.0 × 10.0| 05/22 | 77-77| 34    | 34           | -3   | -3.8         |       |
| 17  | 04/18        | 36  | 4.5 × 8.5 | 05/22 | 80-80| 34    | 34           | 0    | 0            |       |
| 18  | 04/24        | 33  | 4.0 × 8.5 | 06/09 | 83-83| 46    | 46           | 2    | 2.4          |       |
| 19  | 04/24        | 37  | 5.0 × 8.5 | 06/21 | 77-82| 21    | 21           | 0    | 0            |       |
| 20  | 05/13        | 37  | 5.0 × 8.5 | 06/21 | 77-82| 40    | 40           | 5    | 6.3          |       |
| 21  | 05/15        | 46  | 4.8 × 8.0 | 06/24 | 84-85| 40    | 40           | 5    | 6.3          |       |
| 22  | 05/16        | 24  | 4.5 × 8.5 | 06/18 | 70-72| 33    | 33           | 0    | 0            |       |
| 23  | 05/29        | 23  | 4.0 × 10.0| 07/10 | 76-76| 42    | 42           | 15   | 24.6         |       |
| 24  | 05/31        | 35  | 4.0 × 11.5| 07/05 | 75-75| 33    | 33           | -1   | -3.9         |       |
| 25  | 06/07        | 14  | 4.5 × 11.5| 07/05 | 75-75| 33    | 33           | -1   | -3.9         |       |
| 26  | 06/07        | 16  | 4.5 × 8.5 | 07/05 | 69-70| 33    | 33           | -1   | -3.9         |       |
| 27  | 06/12        | 45  | 4.5 × 8.5 | 07/07 | 61-68| 26    | 26           | 0    | 0            |       |
| 28  | 06/12        | 46  | 4.5 × 8.5 | 07/08 | 82-82| 26    | 26           | 0    | 0            |       |
| 29  | 06/28        | 31  | 3.5 × 10.0| 08/22 | 62-62| 55    | 55           | 15   | 31.9         |       |
| 30  | 07/03        | 44  | 4.0 × 8.5 | 08/22 | 75-75| 50    | 50           | -5   | -6.3         |       |
| 31  | 07/03        | 46  | 4.5 × 8.5 | 08/22 | 82-82| 50    | 50           | 10   | 14.1         |       |
| 32  | 07/05        | 22  | 3.5 × 10.0| 08/21 | 63-60| 47    | 47           | 8    | 13.0         |       |
| 33  | 07/10        | 22  | 3.3 × 10.0| 08/20 | 63-63| 41    | 41           |      |              |       |
| 34  | 07/17        | 24  | 4.0 × 10.0| 08/21 | 64-65| 35    | 35           | 1    | 1.5          |       |
| 35  | 07/17        | 26  | 4.5 × 8.5 | 09/09 | 65-65| 54    | 54           | 5    | 8.3          |       |

Note: U: remaining bone thickness is less than 4 mm; G: bone grafting material was applied; S: socket floor elevation was performed; P: platelet-rich fibrin was applied.

Figure 1: Patient distribution in terms of gender and age.
This paragraph seems to have a mix of scientific text and some text that is not clearly structured. Here is a possible way to rewrite it to be more coherent and readable:

buccal-lingual surface of the neck or fixture, resulting in that the occlusal load-bearing capacity after obtaining the osseointegration is relatively easy to obtain. However, if the buccal-lingual width of the bone is large even in the mandibular jaw and the fixture does not touch the dense bone, or in most of the cases with maxillary jaw, the implants will be supported by spongy cancellous bone. This indicates that the available quality and quantity of cancellous bone should be directly related to the occlusal load-bearing capacity. Therefore, implant treatability should be evaluated by examining bone quantity of planned area for implant treatment. If available bone quantity is not enough and the inadequate quality of bone, advanced bone forming technique will be available to establish satisfactory osseointegration. However, there could be a potential risk for bone failure around the placed implant in a long-term usage. Hence, it should be noted that the actual bone quantity per unit surface area (in other words, the surface area of bone in contact with the implant at the implant placement) is less than that judged by the three-dimensional image method [12]. Although bone quality clearly can affect integration rates, additional variables (such as the implant surface conditioning) can also influence a long-term implant performance success. Stach RM, et al. [13] examined outcomes of clinical studies on monitoring the performance of machined-surfaced implants and dual acid-etched Osseotite implants isolating the effect of bone quality and implant surface conditioning. It was reported that (i) for the machined-surfaced implants, the 4-year CSR (cumulative success rate) in all bone sites is 92.7%, (ii) for the implants placed in good (dense and normal) bone, the 4-year CSR is 93.6% compared with the 4-year CSR in poor (soft) bone of 88.2%, and (iii) for Osseotite implants in all sites, their overall 4-year CSR was 98.4%. 98.4% in good bone, and 98.1% in poor bone; concluding that bone quality therefore seems to have a definitive impact on machined-surfaced implants, but this effect was not observed in the Osseotite implant series. On the other hand, Bahat O, et al. [14] reviewed a large series of Bränemark system implants placed in posterior maxillae (660 implants in 202 patients) that have been restored with fixed partial porcelain-fused-to-metal (PFM) restorations and followed for as long as 12 years after loading. Thirteen of the implants (2%) failed between placements and loading, 12 implants were lost between loading and the end of the first year, and 10 failed thereafter, 2 as the result of fractures at 3 and 4 years. It was mentioned that (i) the CSR is 94.4% at 5 to 6 years and 93.4% after 10 years, (ii) the quality and quantity of bone appeared to have little influence on the success rate, (iii) surgical techniques are particularly important to the success of osseointegrated implants placed in the posterior maxilla and (iv) with careful surgical planning and execution, a success rate of approximately 95% at 5 years can be achieved.

There is always debate between immediate loading and early loading. Although no clear definitions for both terms can be found, according to numerous reported publications, it can be said that (i) if superstructure is installed within 48 hours in post-operation period, it can be called as an immediate loading, (2) if it is installed within 1 or 2 weeks, it can be considered as an early loading, and (3) if it is installed after a couple of months, it should be a normal (or delayed) loading.

Chiapasco M, et al. [15] conducted a multicenter retrospective study on 226 patients necessitating an implant-supported overdenture in the lower jaw. The patients were provided with 904 osseointegrated implants inserted in the interferominal region of the mental symphysis (4 implants per patient). Immediately after implant placement, a U-shaped gold bar was fabricated and implants were immediately loaded with an implant-retained overdenture. It was reported that out of 226 patients treated, 194 were followed from a minimum of 2 years to a maximum of 13 years, with a mean follow-up of 6.4 years, whereas 32 patients dropped out during follow-up. The overall failure rate of implants was 3.1% (24/776 implants), whereas the failure rate of bars was 1.5% (3/194 bars). Based on these findings, it was concluded that (i) the success rate of immediately loaded implants was similar to that obtained in the case of delayed loading, after osseointegration has taken place and (ii) in contrast, this method shortens dental rehabilitation times with relevant satisfaction for patients [15]. The conclusion was supported and confirmed by Gatti C, et al. [16], Kinsel RP, et al. [17] and Fischer K, et al. [18]. In order to reach a successful result on the immediate loading, as Esposito M, et al. [19,20] pointed out, a certain initial fixation is a sine-qua-non along with precisely fabricated superstructure with high rigidity.

On the other hand, Romanos GE, et al. [21] evaluated the clinical success of immediately loaded implants versus implants loaded in a delayed fashion in the posterior mandible. Three implants were placed distal to the canines bilaterally in the edentulous distal mandibular ridges of 12 patients. One side was randomly selected for placement of three implants (delayed loading; control sites) with a progressive thread design for submerged healing, and after 3 months the implants were exposed and loaded with provisional splinted crowns, which were replaced 6 weeks later by the definitive restorations. Three additional implants (immediately loaded; test sites), of the same size were placed in the contralateral side of the mandible. It was reported that (i) after a mean loading period of 25.3 months, the patients showed normal mean clinical values without significant differences (P<0.05) for test and control implants, respectively and (ii) after 2 years of loading in the posterior mandible, test and control implants had the same prognosis. Such conclusive remarks were confirmed by other reports [22-25].

As we have seen in the above, there can't be found any definite answer which is the best among immediate loading, early loading and delayed loading. In any event, because elderly patients need a certain type of a bone management such as bone grafting, which requires additional healing time? Accordingly, it is our implant treatment policy not to pursue the immediate loading.
Table 2: Summary of obtained data in terms of patient information, loading date, implant dimension and location, ISQ scales implantation and loading (this study).

| No. | Implant 2018 | Loc. | Type | Age | Sex | ISQ@1 | Days bet. I/L | ISQ@L | ΔISQ | ΔISQ rate (%) |
|-----|--------------|------|------|-----|-----|------|--------------|-------|------|---------------|
| 1   | 08/24        | 45   | TS3  | 59  | M   | 80-80 | 49           | 81-87 | 4    | 5.0           |
| 2   | 08/25        | 25   | TS3  | 65  | F   | 67-74 | 62           | 76-75 | 5    | 7.1           |
| 3   | 08/25        | 26   | TS3  | 65  | F   | 71-71 | 62           | 75-75 | 4    | 5.7           |
| 4   | 08/30        | 13   | SF   | 67  | M   | 70-70 | 50           | 68-68 | 2    | -0.3          |
| 5   | 08/30        | 14   | SF   | 67  | M   | 62-62 | 50           | 65-65 | 3    | 4.8           |
| 6   | 09/08        | 42   | TS3  | 41  | M   | 52-52 | 59           | 61-61 | 9    | 17.3          |
| 7   | 09/08        | 44   | TS3  | 41  | M   | 82-81 | 31           | 75-81 | 1    | -1.2          |
| 8   | 09/14        | 35   | TS3  | 69  | F   | 82-83 | 48           | 85-85 | 2    | 2.4           |
| 9   | 09/14        | 36   | TS3  | 69  | F   | 84-84 | 48           | 86-86 | 2    | 2.4           |
| 10  | 09/20        | 26   | SS3  | 43  | F   | 73-70 | 50           | 69-69 | 1    | -1.4          |
| 11  | 09/21        | 26   | SS3  | 71  | F   | 67-64 | 53           | 65-66 | 0    | 0             |
| 12  | 09/21        | 35   | SS3  | 48  | M   | 140 G | 59-62        |       |      |               |
| 13  | 09/21        | 36   | SS3  | 48  | M   | 140 G | 63-60        |       |      |               |
| 14  | 09/25        | 12   | TS3  | 33  | F   | 61-67 | 43           | 62-62 | 0    | 0             |
| 15  | 09/27        | 35   | BLT  | 70  | F   | 48-53 | 48           | 65-65 | 15   | 30.0          |
| 16  | 09/27        | 36   | BL   | 70  | F   | 17-22 | 48           | 64-64 | 44   | 220           |
| 17  | 09/28        | 35   | SS3  | 68  | F   | 43-41 | 65           | 59-59 | 17   | 40.5          |
| 18  | 09/29        | 16   | TS3  | 68  | F   | 56-57 | 42           | 65-67 | 8    | 14.3          |
| 19  | 10/12        | 26   | SS3  | 61  | F   | 71-71 | 43           | 64-65 | 6    | -8.5          |
| 20  | 10/16        | 34   | TS3  | 58  | F   | 69-79 | 92           | 78-70 | 4    | 5.7           |
| 21  | 10/16        | 36   | TS3  | 58  | F   | 64-64 | 92           | 64-64 | 0    | 0             |
| 22  | 10/16        | 46   | TS3  | 58  | F   | 82-86 | 65           | 86-85 | 1    | 1.2           |
| 23  | 10/23        | 13   | BLT  | 89  | M   | 70-75 | 40           | 75-75 | 3    | 4.2           |
| 24  | 10/26        | 24   | TS3  | 80  | F   | 84-84 | 46           | 70-70 | 15   | -17.9         |
| 25  | 11/13        | 13   | TE   | 82  | F   | 44-46 | 70           | 70-69 | 25   | 55.6          |
| 26  | 11/15        | 13   | TS3  | 38  | F   | 14-16 | 62           | 70-69 | 55   | 366           |
| 27  | 11/24        | 11   | TS3  | 41  | M   | 86-81 | 46           | 79-81 | -3   | -3.6          |
| 28  | 11/24        | 12   | TS3  | 41  | M   | 75-79 | 46           | 79-79 | 2    | 2.6           |
| 29  | 11/24        | 22   | TS3  | 41  | M   | 84-80 | 46           | 72-71 | -9   | -10.9         |
| 30  | 11/26        | 15   | SS3  | 70  | F   | 77-77 | 53           | 76-76 | -1   | -1.3          |
| 31  | 11/29        | 35   | SS3  | 65  | F   | 56-57 | 50           | 80-80 | 22   | 39.3          |
| 32  | 11/29        | 36   | SS3  | 65  | F   | 77-76 | 50           | 79-79 | 2    | 2.6           |
| 33  | 11/29        | 44   | SS3  | 65  | F   | 69-70 | 82           | 64-64 | 3    | -4.2          |
| 34  | 11/30        | 46   | SS3  | 70  | F   | 70-71 | 42           | 72-73 | 2    | 2.8           |
| 35  | 11/30        | 47   | SS3  | 70  | F   | 77-77 | 42           | 72-75 | -2   | -2.6          |
| 36  | 12/01        | 16   | TS3  | 48  | F   | 43-48 | 49           | 64-64 | 19   | 41.3          |
| 37  | 12/07        | 34   | BLT  | 82  | F   | 82-82 | 75           | 77-77 | -5   | -6.1          |
| 38  | 12/07        | 36   | BLT  | 82  | F   | 43-43 | 86           | 66-67 | 23   | 60.4          |
| 39  | 12/11        | 35   | TS3  | 51  | M   | 83-73 | 31           | 71-71 | -4   | -5.0          |
| 40  | 12/11        | 36   | TS3  | 51  | M   | 66-66 | 31           | 79-63 | 10   | 15.2          |

Note: TS3: Osstem SA (sand-blasted and acid treated) Implant; SS3: ditto; SF:Shofu Implant; BLT: Straumann SLA (sand-blasted with large grain of alumina and acid treated) Implant ; BL: ditto; TE: ditto

Figure 1 indicates that we had more female (and aged elderly) implant patients. Fuster-Torres MA, et al. [26] also mentioned that there were more female patients than male subjects, more implants were placed in female patients than male patients. At this moment, no clear elucidation for this trend can't be made.

From figure 2, it was observed that (i) improvement in ISQ was more remarked in female patients than male ones, (ii) female patients tend to maintain original ISQ value during healing period than male ones and (iii) even lowest ISQs found in female patients were 58 scale, these were acceptable values. López AB, et al. [27] measured ISQ values during the osseointegration period and determined the factors that affect implant stability on 24 patients (12 women, 12 men) with a total 64 implants (10 anterior maxilla, 12 posterior maxilla, 18 anterior mandible and 24 posterior mandible). It was found that (i) the mean ISQ of all measured implants was 62.6, (ii) the lowest mean stability measurement was at 4 weeks for all bone types (60.9) and (iii) gender difference was found to be significant (p<0.05); women showed higher implant stability than men, which somewhat confirmed the present
results. However, this doesn’t agree with the observation that a meta-analysis of studies on reported ISQ scales for male and female subjects suggested that there is a trend for male patients to have a higher ISQ value than female ones; however, no significant difference there between was found [3].

Turkyilmaz I, et al. [28] determined the local bone density in dental implant recipient sites using Computerized Tomography (CT) and to investigate the influence of local bone density on implant stability parameters and implant success. A total of 300 implants were placed in 111 patients. The resonance frequency analysis measurements were performed with Osstell instrument immediately after implant placement, 6, and 12 months later. It was found that (i) 20 (out of 300 placed implants) were lost, meaning a survival rate of 93.3 after three years (average 3.7 ± 0.7 years), (ii) the mean ISQ value for all 300 patients was 65.7 ± 9 ISQ and (iii) the mean ISQ value for 280 successful implant cases was 67.1 ± 7 ISQ, which indicated statistically significant differences (p<0.001).

Cornelini R, et al. [29] placed 40 implants in twenty patients with missing mandibular premolars and molars and reported that for 39 successful implants as one implant was lost, the mean ISQ values were 72 and 74.5 at implant surgery and after one year, which was not statistically significant. The follow-up study by Degidi M, et al. [30] included 802 dental implants placed in 321 patients, and minimum observation period was one year for each implant in that study and indicated that the failed implants showed a mean ISQ value of 46, while the successfully osseointegrated implants had ISQ values around 60. Sjöström M, et al. [31] placed 192 implants after 6 months of bone grafting healing. Implant stability was measured four times using RFA for 190 implants, and they lost 20 implants, which means a survival rate of 90% during the 3-year follow up. It was reported that (i) the ISQ value for all implants differed significantly between abutment connection (60.2 ± 7.3) and after 6 months of bridge-loading (62.5 ± 5.5) but were not significant between implant placement (61.9 ± 9.5) and abutment connection (60.2 ± 7.3), and also 6 months of bridge-loading (62.5 ± 5.5) and 3 years of bridge-loading (61.8 ± 5.5), (ii) when comparing individual implants, the mean ISQ at placement for 170 successful implants was 62.6 ± 11.1 compared to 54.9 ± 11.1 for 20 failed implants, which indicated a significant difference and (iii) when compared to the failed implants, the higher ISQ values were found in the successful implants, and when all successful implants were considered the ISQ values slightly decreased following implant placement and then increased up to 1-year.

Similarly, for this study, the followings were calculated, based on tables 1 and 2. ISQs measured at implant placement (ISQ@L) are 69.8 ± 11.7 for total, in which 71.2 ± 9.9 for male patients and 67.0 ± 13.6 for female patients, while ISQs measured at loading (ISQ@L) are 71.7 ± 7.5 for total, in which 72.0 ± 7.5 for male patients and 70.3 ± 7.5 for female patients. Figure 3 compares various ISQ values reported in references cited in this paper. The number in (parenthesis) indicates the reference number; “I” stands for ISQ measured at implant placement and “L” for that at loading. For the present study, open circles represent the total average ± standard deviation, red solid marks are average ± SD for female subjects and blue solid circles are average ± SD for male subjects, respectively. For reference, there are additional Δ data in the figure, indicating ISQ values for the failed cases.

From figure 3, it can be said that ISQ value should have at least 60 to exhibit successful implant treatment.

Conclusions

Within limited number of implant patient cases, it was concluded that (i) UV surface alteration and enough blood supply by piezosurgery preparation exhibited synergistic effects on improvement of ISQ scales, indicating that these dual techniques appears applicable to implant treatments, (ii) number of elderly female implant patients were more than male patients, (iii) ISQ scales increased during the bone healing stage, independent of age and gender issues, and (iv) there is a critical value of ISQ for successful implant treatment and it is at least 60.

Minimally invasive, safe and reliable, and early functional recovery is common demands nowadays from implant patients. However, there is still a considerable risk of immediate load for both a practitioner and a patient. Even under recognized synergistic effects of piezosurgery and UV treatment, in addition to use of medium length implants, we prefer to take our standard for implant treatment to be “semi-early loading”, indicating that the loading can be started sometime between one and two months after the implant placement and if ISQ exceeds always the 60-criterion.

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