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Stability of Immediately Placed and Delayed Implants Using Resonance Frequency Analysis (RFA). A Systematic Review

Sara H. Younisab, Catherine I. Radana, Doha M. Galala, Heba K. Abdul-Fattah, John A. Labib

Abstract

Aim: The aim of the present Systematic Review was to compare between immediate and delayed dental implant placement using resonance frequency analysis specifically Implant Stability Quotients (ISQ). Methods: Search was performed in two databases (PubMed and Cochrane Library) till March 2023. Randomized clinical trials (RCTs) were included and measurements of ISQ at time of placement and time of loading were recorded. We excluded papers discussing bone grafting, orthodontic treatment and implant surface treatment. Results: Results were above ISQ threshold value of 65, with no significant difference between immediate and delayed implants. However, Immediate placement showed shorter treatment time and better esthetic outcome. Conclusion: Implant stability can be achieved with both immediate and delayed implant placement techniques.

1. INTRODUCTION

Implant is a material or an object (alloplastic substance), partially or completely inserted into the body for therapeutic, diagnostic, prosthetic, or experimental purpose. Immediate implant placement refers to placing a dental implant in an extraction socket at the time of extraction, why wait when it can be done right away is a recent thought.1

Delayed implant placement is implant placement twelve weeks or more after extraction. It allows for elimination of infective processes, the achievement of maximum osteoblastic activity that helps the osseointegration process and complete wound covering that simplifies the placement of grafts or membranes.2

ISQ (Implant Stability Quotient) technology is a non-invasive diagnostic tool used to measure the stability of dental implants. It works by analyzing the implant’s vibrational frequency and providing a numerical value.3 ISQ technology uses a small, handheld device that is placed on the implant and provides real-time information on its stability. This information can be used to monitor the healing progress of the implant, assess the success of osseointegration and determine the appropriate timing for loading the implant.4 ISQ technology provides a more objective measurement of implant stability compared to other methods, which rely on subjective assessments by the clinician. The scale ranges from 1 to 100, with higher values indicating greater stability. The acceptable stability range lies between 55 and 85 ISQ.5

2. METHODS

This SR was reported following the guidelines of the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklist. (Figure 1).
A PICO model (Problem, Intervention, Control and Outcome) was constructed.

**P: Implant stability**

**I: Immediate implant placement**

**C: Delayed implant placement**

**O: ISQ measurements**

**Eligibility Criteria**

Randomized clinical trials (RCTs) including Immediate implant placement (immediately after extraction), delayed implant placement and measurement data of ISQ at time of placement and at time of loading were included in this SR.

During primary screening (from title and abstract), we excluded one systematic review, 8 papers discussing implant loading, 3 papers discussing bone graft, one paper discussing orthodontic treatment and one paper studying implant surface treatment. After full text reading (secondary screening) we excluded 1 paper studying ISQ sensitivity and 1 paper discussing narrow implants in anterior region. (Figure 1).

**Information Sources**

Search was performed in PubMed and Cochrane Library (2015 through March 2023) (Figures 2 and 3). Materials and Methods of the included studies are described in (table 1).
Table (1) Methodology table

<table>
<thead>
<tr>
<th>Author</th>
<th>Year</th>
<th>Study design</th>
<th>Number of samples</th>
<th>Age</th>
<th>Implant Region</th>
<th>Maxilla</th>
<th>Mandible</th>
<th>ISQ</th>
<th>Immediate</th>
<th>Delayed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granic et al.</td>
<td>2015</td>
<td>RCT</td>
<td>60</td>
<td>&lt;20</td>
<td>Premolar</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Rowan et. al.</td>
<td>2015</td>
<td>RCT</td>
<td>85</td>
<td>19-93</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>41</td>
<td>96</td>
</tr>
<tr>
<td>Ning et. al.</td>
<td>2019</td>
<td>RCT</td>
<td>86</td>
<td>N/A</td>
<td>Anterior premolar</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>46</td>
<td>40</td>
</tr>
<tr>
<td>Malchiodi et al.</td>
<td>2016</td>
<td>RCT</td>
<td>40</td>
<td>54 median</td>
<td>Premolar/Molar</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Huang et al.</td>
<td>2016</td>
<td>RCT</td>
<td>177</td>
<td>19-100</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>71</td>
<td>106</td>
</tr>
<tr>
<td>Tallarico et al.</td>
<td>2017</td>
<td>RCT</td>
<td>24</td>
<td>N/A</td>
<td>Molar</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>12</td>
<td>12</td>
</tr>
<tr>
<td>Huang et al.</td>
<td>2017</td>
<td>RCT</td>
<td>336</td>
<td>19-100</td>
<td>N/A</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
<td>172</td>
<td>385</td>
</tr>
</tbody>
</table>

Risk of Bias

All studies were assessed for risk of bias.

Table (2) Risk of Bias table.

<table>
<thead>
<tr>
<th>Author</th>
<th>Selection</th>
<th>Performance</th>
<th>Detection</th>
<th>Attrition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granic et al.</td>
<td>N/A</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Rowan et. al.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>N/A</td>
</tr>
<tr>
<td>Ning et. al.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Malchiodi et al.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Huang et al.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Tallarico et al.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>Huang et al.</td>
<td>No</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
</tr>
</tbody>
</table>

3. RESULTS

Table (3) The results of the selected 7 studies.

<table>
<thead>
<tr>
<th>Author</th>
<th>Immediate dental implant</th>
<th>Delayed dental implant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Granic et al.</td>
<td>63.5 ± 6.2, 70.3 ± 5.1, and 73.8 ± 4.7 at baseline, 6 weeks, and 12 weeks post-implantation, respectively.</td>
<td>62.9 ± 5.9, 69.2 ± 4.8, and 73.3 ± 4.6 at baseline, 6 weeks, and 12 weeks post-implantation, respectively.</td>
</tr>
<tr>
<td>Rowan et. al.</td>
<td>Mean ISQ values in the 2 immediate implant groups exceeded the ISQ threshold of 65. Immediately placed implants in the 2- to 3-month and 4- to 6-month groups had average ISQ values of 65.60 and 68.65, respectively. Follow up had averages of 73.88 and 70.14.</td>
<td>Averages of 76.73 (2- to 3-month group) and 71.23 (4- to 6-month group). Follow up 79.58 (2- to 3-month group) and 77.31 (4- to 6-month group)</td>
</tr>
<tr>
<td>Ning et. al.</td>
<td>Results were above ISQ threshold value of 65, which suggests no significant difference between immediate and delayed implant stability.</td>
<td></td>
</tr>
<tr>
<td>Malchiodi et al.</td>
<td>Results were above ISQ threshold value of 65, which suggests no significant difference between immediate and delayed implant stability.</td>
<td></td>
</tr>
<tr>
<td>Huang et al.</td>
<td>Immediately after implantation 73.68±6.50 And right before loading 77±4.30</td>
<td>Immediately after implantation 75.82±5.49 And right before loading 77.63±4.07</td>
</tr>
<tr>
<td>Tallarico et al.</td>
<td>6 months after implant placement, mean ISQ value was 78.8 ± 2.8 1 year after loading, mean PES was 10.6 ± 1.8 [range: 8 to 13]</td>
<td>6 months after implant placement, mean ISQ value was 79.9 ± 3.6 1 year after loading, mean PES was 12.2 ± 1.2 [range: 11 to 14]</td>
</tr>
</tbody>
</table>
4. DISCUSSION

Immediate implant placement has become increasingly popular due to its advantages; shorter treatment time and preservation of alveolar bone. However, concerns have been raised regarding the stability of immediately placed implants. These studies provide evidence that immediate implants can achieve comparable or even higher stability than delayed implants when assessed using RFA. It is worth noting that there were discrepancies between the studies in terms of which technique resulted in higher stability values over time.

Granić et al.⁶ found that immediate placement resulted in higher stability values over time, Rowan M et al.⁷ found a trend towards immediate placement group due to reaching ISQ value threshold above 65.

Huang et al⁸ compared the rate of success, stability of the implants, probing depth, aesthetics, marginal bone level and satisfaction after follow-up, records were taken 3 months after implant placement and at the time of permanent restoration, with a non-invasive extraction, results suggested that delayed and immediate implant placement both had good results in means of stability, however, immediate implantation showed better satisfaction, concerning aesthetics and clinical application.

Malchiodi et al⁹ investigated the performance of implants inserted either in fresh extraction sockets or after 12-week healing period. Implant success and survival rate, when assessed at the 12-month follow-up, were 100% in both groups.

Huang et al¹⁰ suggested that immediate implant placement had several advantages; reduced surgical trauma, short time of treatment and better conservation of soft tissue and bone. They also found that immediate implants had long term success rate and better esthetics when compared to delayed implant placement. However, they stated that immediate implant technique is considered sensitive concerning gaining primary stability which if not achieved, high rate of implant failure will occur.
Tallarico et al.\(^\text{11}\) suggested that both immediate and delayed implants achieved good results in 1-year follow-up period concerning implant stability, while waiting after extraction for 4 months and using socket preservation technique caused less Cristal bone loss & resulted in better aesthetics.

Huang et al.\(^\text{12}\) findings suggested that Immediate/delayed implantation did not have any significant influence on the ISQ values and implant stability. Also other factors like Sex, Age, Maxillary/mandibular location, Implant diameter, Insertion torque, Bone type and time interval, had no significant influence on the ISQ values and implant stability. While bone grafting was considered the only influencing factor on ISQ values and implant stability and Implant length was considered insignificant influencing factor.

After assessment of all previous findings both immediate and delayed implant placement revealed stable implants results. However, clinicians should consider the specific needs of each patient when deciding which technique to use. Immediate placement may be preferable for patients who require shorter treatment times or have concerns about bone preservation, while delayed placement may be preferable for patients who require higher stability values over time.

### Limitations of the Review Process

This SR included only peer-reviewed studies published in English, but this did not affect the study conclusions. And searched in only two databases (PubMed and Cochrane Library).

### 5. CONCLUSION

Implant stability can be achieved with both immediate and delayed implant placement techniques. Immediate placement allows shorter treatment time, preservation of alveolar bone and better esthetic effect.

Further research is needed to explore other factors (implant design or surgical technique) that may affect implant stability over time, and to fully understand the long-term outcomes of immediate and delayed implant placement.

### 6. REFERENCES


