The immediate loading of implant-supported full-arch fixed prostheses is successful and predictable for years. In addition to the reduction of treatment time, it provides quicker oral function and esthetics.\(^1\) Primary stability at implant placement is an essential requirement for successful osseointegration in immediate loading.\(^2\) The insertion torque value is a biometric parameter that is useful for effectively assessing the primary stability of the implant.\(^3\) Various factors significantly influence the insertion torque value during placement of the implant, including alveolar bone quality and quantity, implant geometry, and drilling technique.\(^5\) Through a systematic review and meta-analysis, Schimmel et al revealed that most investigators proposed 35 Ncm as a threshold for an immediate loading protocol.\(^6\) Several authors advocated an underpreparation approach to achieve an adequate insertion torque upon implant placement.\(^7,8\) Attaining an insertion torque > 35 Ncm is easily achievable in the very dense mandibular bone; however, it is difficult to attain an adequate insertion torque in the less-dense maxilla bone even when the underpreparation protocol is employed. Even in the same arch, various insertion torque values might be attained in different regions with

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distinct bone quality even if the most conservative drilling procedure was used.

However, a few implants with low insertion torque values in implant-supported full-arch fixed prostheses are not contraindicated for immediate loading because a cross-arch splinting prosthetic device could provide secondary fixation as an additional benefit.9

Successfully integrated implants may be subjected to bone and/or osseointegration losses due to unfavorable occlusal load.10 Currently, several guidelines and principles were introduced for full-arch fixed prostheses with integrated implants. Bilateral balanced occlusion was recommended for an antagonistic complete denture; however, group function occlusion was utilized for antagonistic natural dentition.11 Wismeijer et al suggested mutually protected occlusion for opposing natural dentition.12 Moreover, Taylor et al proposed anterior working contacts to prevent posterior overloading.13 However, in a review of the literature, no scientific evidence–based guidelines are currently available to decide how occlusion for these types of treatment is best managed clinically.14 During the initial healing period before osseointegration for immediately loaded fixed prostheses with a few implants with low insertion torque, an optimized occlusal adjustment with an adequate occlusal scheme should be performed precisely. Nevertheless, no relevant scientific evidence can prove this.

Thus, this retrospective study aimed to compare the proportion of implants with low insertion torque between the maxilla and the mandible after using the underpreparation protocol. In addition, factors affecting the implants with low insertion torque were investigated. Furthermore, the outcomes of implants placed with low insertion torque (< 35 Ncm) in immediately loaded full-arch fixed prostheses used with different occlusal designs were investigated.

MATERIALS AND METHODS

Study Design
This retrospective clinical study was performed in Kaohsiung Chang Gung Memorial Hospital located in southern Taiwan. The study protocol was approved by the Institutional Review Board of Chang Gung Medical Foundation in Taiwan. Patients received immediately loaded full-arch implant-supported fixed prostheses between October 2013 and July 2017. Informed consent for data collection was obtained from all patients.

The presurgical dental evaluation consisted of extraoral and intraoral examinations, smile analysis, occlusal analysis, and parafunctional habit survey. A comprehensive presurgical evaluation of systemic diseases and pre-anesthesia screening were performed. The preoperative radiographic examination included panoramic and periapical radiography as well as CBCT. Maxillary rehabilitation was constructed with four to six implants, which were all regular implants (NobelSpeedy Groovy, NobelActive, or NobelParallel CC, Nobel Biocare) or regular implants combined with zygomatic implants (Brånemark System Zygoma or NobelZygoma, Nobel Biocare). Mandibular rehabilitation was initiated with four regular implants.

Selection Criteria
Full-arch fixed prostheses supported by at least four implants and at least one immediately loaded regular implant with low insertion torque were included. Maxillary rehabilitations with more than one zygomatic implant on the same side were excluded. Only the insertion torque value of the zygomatic implants was recorded as part of the entire arch value. Other data such as the length and width of the zygomatic implants were not within the scope of this study. In addition, implants inserted and submerged for healing were not analyzed.

Surgical Procedure
All surgical procedures were performed under general anesthesia. After applying local anesthesia to reduce the bleeding tendency, a mucoperiosteal flap was raised. All the remaining teeth were extracted, and each extraction socket was completely debrided. Osteotomy and osteoplasty could be indicated if the gingival line was displayed when smiling or the restorative space was insufficient.

When four implants were indicated, two anterior axial implants and two posterior angulated implants were placed in the maxilla and mandible using the All-on-4 treatment concept (Nobel Biocare).15,16 When five implants were planned, the three anterior implants inserted were equally distributed in the intercanine area. When six implants were indicated, four anterior implants and two posterior implants were evenly distributed in the maxillary central incisor, canine, and second premolar regions. If the bone was unavailable in the premolar or molar region, the use of the zygomatic implant was unavoidable. To obtain bicorticalization, longer implants were preferable. The insertion torque for each implant was recorded. The inserted implants with exposed threads at the extraction socket were recorded as immediate placement.

Multiunit abutments (Nobel Biocare) were connected to the implants. To ensure long-term success, guided bone regeneration could be conducted if any bony dehiscence or fenestration around the implants were present. For insertion torque values < 10 Ncm, the implants placed were submerged for healing for at least 3 months. The periosteal flaps were sutured using 4–0 resorbable sutures (Vicryl, Ethicon). Pickup impressions with wrought wire splinting were made right after surgery.
After the operation, the patients were prescribed a nonsteroidal anti-inflammatory drug and antibiotics, ie, amoxicillin or clindamycin, for 7 days. They were also instructed to use mouthwashes for 2 weeks until physical cleaning was permitted.

Provisional Prosthetic Procedure and Occlusal Schemes

A screw-retained acrylic prosthesis was delivered within 3 to 5 days after surgery. This screw-retained provisional prosthesis was reinforced by either wrought wire or a cast metal bar. After healing, panoramic and periapical radiographs were taken. The 10-unit prostheses were fabricated without distal cantilevers.

Based on the number and distribution of implants with low insertion torque, the different occlusal designs were divided into the following three groups (Fig 1 and Table 1):

- **Group 1**: If the implants with low insertion torque were located in the posterior region, either on one side or both sides, centric contact and lateral excursion were limited between the intercanine region.
- **Group 2**: If the implants with low insertion torque were located in the anterior region (canine to canine) and there was at least one anterior implant with an insertion torque value ≥ 35 Ncm on both sides, the preferred occlusal setting was anterior occlusal contact with disocclusion of the tooth supported by the implant with low insertion torque.
- **Group 3**: Three situations were classified as group 3. First, there were no anterior implants with an insertion torque value ≥ 35 Ncm on either side. Second, more than half of the inserted implants had low insertion torque values. Third, implants with low insertion torque completely occupied one side and implants with an insertion torque value ≥ 35 Ncm completely occupied the other side. In this group, the designed occlusal setting was equally distributed occlusal contact with disocclusion of the implants with a relatively lower insertion torque value.

Patients were strongly advised to consume a soft diet during the healing period. They should carefully avoid removing the provisional fixed prostheses until 3 months later.

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**Table 1 Occlusal Scheme According to Different Situations**

<table>
<thead>
<tr>
<th>Situation</th>
<th>Occlusal scheme</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group 1: Implants with low insertion torque only located in the posterior region</td>
<td>Occlusal contact limited between the intercanine region</td>
</tr>
<tr>
<td>Group 2: Implants with low insertion torque located in the anterior region, but at least one anterior implant with insertion torque value ≥ 35 Ncm present on both sides</td>
<td>Occlusal contact limited between the intercanine region, discarding occlusal contacts on the implants with low insertion torque</td>
</tr>
</tbody>
</table>
| Group 3: 1. No anterior implants with insertion torque value ≥ 35 Ncm on either side  
2. More than half of the inserted implants had low insertion torque value  
3. Implants with low insertion torque completely occupied one side and implants with insertion torque value ≥ 35 Ncm completely occupied the other side | Equally distributed occlusal contact, discarding occlusal contacts on implants with relatively lower insertion torque value |
Patients were seen routinely every week for the first month after surgery and then every 2 to 4 weeks depending on their oral hygiene and soft tissue status. The provisional fixed prostheses were used for approximately 12 weeks. All abutments were checked using a manual torque control device against a recommended torque value before the definitive impression was obtained. If there were mobile implants, spinning implants, radiolucent image around the implants, tenderness, or severe infection around the implants, these were recorded as a failure of osseointegration. Moreover, an implant removed for any reason was recorded as a failure, and the implants still functioning were counted as survivals.

Regarding the definitive prostheses, according to the patients’ preference, metal-ceramic prostheses or metal–acrylic resin prostheses were placed 4 months after surgery. The 12-unit definitive prostheses were designed to allow a posterior cantilever for enhanced chewing capability. Occlusal contacts were uniformly distributed with canine guidance in lateral excursions.

Follow-up Protocol
Patients took part in a maintenance protocol with clinical examinations at 2 weeks, 1 month, 2 months, and every 3 months thereafter. The clinical examination encompassed the soft tissue status, prosthesis integrity, occlusal equilibrium, and oral hygiene performance. The radiographic examinations were performed every 12 months.

Statistical Analysis
Statistical analysis was conducted using SPSS for Windows version 22 (IBM). In the 144 patients, the proportion of implants with a low insertion torque value was calculated in the maxilla and mandible, and these were compared by the Pearson chi-square test; zygomatic implants were excluded from the calculation.

Fisher exact or Pearson chi-square test was used to determine if there was any association between implants with a low insertion torque value and implant length, implant width, anatomical location, or immediate placement. The cumulative survival rate was calculated using the Kaplan-Meier method. The cumulative survival rate was also calculated, excluding the zygomatic implants and submerged implants.

Furthermore, the log-rank test was utilized to compare the survival rate of implants with insertion torque values ≥ 35 Ncm and < 35 Ncm. The significance level was set at 5% (α = .05).

RESULTS

During the study period, 144 patients were treated with immediately loaded implant-supported full-arch fixed prostheses, and 608 and 304 regular implants were inserted in 118 maxillae and 76 mandibles, respectively.
Forty-two patients (11 men and 31 women) with an average age of 54.6 (range: 28 to 66) years at the time of surgery were included in the study. The mean follow-up time was 3.7 ± 1.2 (range: 0.6 to 5.8) years. Forty-one patients had a single arch with at least one implant with low insertion torque, and one patient had two arches with implants with low insertion torque. The 43 arches (39 maxillae and 4 mandibles) had four to six implants per arch (Tables 2 and 3). A total of 238 implants, including 10 zygomatic implants, were placed. One implant was inserted using a two-stage protocol after bone augmentation, as insufficient alveolar bone was available and the patient refused to receive a zygomatic implant.

All 43 arches were successfully constructed with immediately loaded fixed full-arch provisional prostheses. A total of 222 regular (non-zygomatic) implants implants and 10 zygomatic implants were immediately loaded, and 69 of the regular implants were inserted with low insertion torque (64 and 5 in the maxilla and mandible, respectively; Table 4). Of the 69 implants in five maxillae, five were left to heal and submerged because either the insertion torque was only 5 Ncm or a greenstick fracture occurred around the implant with 10 to 15 Ncm. The proportion of implants with a low insertion torque value was significantly greater in the maxilla than in the mandible (10.5% vs 1.6%, respectively, P < .001).

Implant length ranged within 10 to 18 mm, and the implant width was 3.3, 4.0, 4.3, or 5.0 mm. No significant association was found between implant length and low insertion torque value (P = .948), whereas implants with a width of 3.3 mm had a significantly greater proportion with a low insertion torque value than 4-mm-wide implants (P = .002).

Fifty-nine implants were recorded as immediate placement. The proportion of immediately placed implants achieving an insertion torque value ≥ 35 Ncm was significantly greater than that with a low insertion torque value (48 vs 11, respectively, P = .023). The statistical analysis showed no association between the specific position and low insertion torque value (P = .317). Statistical analysis results also showed that the insertion torque value was not associated with the anterior/posterior region (P = .401; Table 5). The antagonist arches included implant-supported full-arch fixed prostheses (n = 21), natural dentition (n = 21), and complete denture (n = 1).

Three regular implants were registered as failures. One anterior implant with an insertion torque value ≥ 35 Ncm failed to achieve osseointegration during the initial healing period. A reinsertion procedure was performed upon removal of the failed implant. In one patient, two implants with successful anterior osseointegration (one implant with a low insertion torque value and another with an insertion torque value ≥ 35 Ncm) were deliberately removed at 3 months after surgery because of buccal gingival dehiscence caused by early membrane exposure; however, the prosthesis survived on the remaining four implants, and the implants were reinserted thereafter.

During the entire follow-up period, all prostheses were still functioning. The provisional prostheses did not present any major complications, except for three cases of small chipping of the acrylic teeth. The chipping was promptly repaired without detaching the prosthesis.

The overall cumulative survival rates were 98.6% for the implants and 100% for the prostheses. Implant survival rates for insertion torque values < 35 Ncm and ≥ 35 Ncm were not significantly different (98.4% and 98.7%, respectively, P = .866).

The distribution of the provisional prostheses according to the occlusal schemes is presented in Table 6. The majority of the rehabilitations were included in groups 1 and 2. No more than two implants with low insertion torque values were seen in groups 1 and 2. In group 3, two arches had more than three implants with low insertion torque values. The first arch was

### Table 5 Implant Distribution According to Insertion Torque (< 35 Ncm or ≥ 35 Ncm) and Anterior/Posterior Region

<table>
<thead>
<tr>
<th>Region</th>
<th>Anterior maxilla</th>
<th>Posterior maxilla</th>
<th>Anterior mandible</th>
<th>Posterior mandible</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>35 Ncm (no., %)</td>
<td>103 (71.0)</td>
<td>44 (66.7)</td>
<td>7 (87.5)</td>
<td>4 (50)</td>
<td>.401</td>
</tr>
<tr>
<td>&lt; 35 Ncm (no., %)</td>
<td>42 (29.0)</td>
<td>22 (33.3)</td>
<td>1 (12.5)</td>
<td>4 (50)</td>
<td></td>
</tr>
</tbody>
</table>

### Table 6 Provisional Distribution According to Occlusal Scheme

<table>
<thead>
<tr>
<th>Occlusal Scheme</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Group 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prosthesis supported by six implants</td>
<td>8</td>
<td>13</td>
<td>2</td>
</tr>
<tr>
<td>Prosthesis supported by five implants</td>
<td>2</td>
<td>9</td>
<td>3</td>
</tr>
<tr>
<td>Prosthesis supported by four implants</td>
<td>4</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Total</td>
<td>14</td>
<td>23</td>
<td>6</td>
</tr>
</tbody>
</table>
rehabilitated with six implants in the maxilla, of which four implants had low insertion torque values. The second arch was treated with six implants in the maxilla, of which five had low insertion torque values.

**DISCUSSION**

The appropriate value of the insertion torque illustrated for biomechanical stability of the implant and bone was considered the prerequisite factor in immediate loading. However, no conclusive torque value to attain osseointegration while applying the immediate-function concept was identified. Several studies have suggested that 35 Ncm was a threshold for the immediate loading protocol. Nevertheless, it was difficult to achieve the preferred torque value in the softer maxilla or extremely resorbed bone. This implied that the immediate-function protocol might be abandoned and that patients would have compromised esthetics and chewing ability for several months.

A preoperative bone density assessment was suggested to predict the initial insertion torque value, as the insertion torque value was correlated with bone density. However, there is a difference in bone density between the maxilla and mandible or the anterior and posterior regions. The proportion of low insertion torque values in this study was greater for implants in the maxilla than for those in the mandible. Farré-Pagés et al found similar results, wherein the mean insertion torque value of maxillary implants was lower than that of mandibular implants. Furthermore, after using the manufacturer-recommended drilling protocol, they found that the mean insertion torque values were greater in the anterior region than in the posterior region. However, this was contrary to the present results. In the present study, a low insertion torque value was not significantly associated with the specific implant position or anterior/posterior region, whether the implant was in the maxilla or mandible. This might be explained by altering drilling sequences to compensate for the disparity in the bone density.

The results of the present investigation showed no association between implant length and low insertion torque value. This clinical finding was consistent with other studies. However, longer implants were preferred in this study because they were hypothesized to have beneficial effects on the resistance form of the implant-prosthesis complex. Engelke et al found that longer implants (15 mm) had remarkably lower displacement with static lateral force than that of short implants (8.5 mm) in type 4 bone. Additionally, in a retrospective study, Degidi et al concluded that immediately loaded longer implants (> 13 mm) had better implant survival rates than standard implants (13 mm).

Bilhan et al investigated the influence of surgical technique and implant-related factors on primary stability in cow ribs. They reported that wider implants could obtain greater insertion torque values. Although the 4.0-mm implant width was associated with greater insertion torque values in the present study, this result should be cautiously interpreted because of the small number of implants with a wider width (4.3 and 5.0 mm) in the present study. Due to the variability of bone density, a different drilling protocol was employed subjectively by the surgeon. The undersized drilling technique can improve the primary stability of implants placed in poor-quality bones. The diameter of the last drill adopted may significantly affect the insertion torque value. In addition, in the present study, 3.3-mm-diameter implants were frequently applied in the extremely narrow ridge, which had insufficient bone to be engaged with.

Bavetta et al investigated the primary stability of immediately loaded implants placed in fresh extraction sockets or a healed socket and found that implants placed in fresh extraction sockets had a significantly lower implant stability quotient than those placed in healed sockets. These results opposed those of the present study, where implants placed in the extraction socket were associated with greater insertion torque values. In the present study, to gain more stability, the implant position was shifted toward the palatal aspect or the interdental bony septum. This approach allowed the implant to engage the socket wall, which was highly cortical.

This retrospective study investigated the treatment outcomes with immediately loaded implant-supported full-arch fixed prostheses. This clinical study found that implants with low insertion torque did not jeopardize the outcomes because of the meticulous strategy of the occlusal setup. The cumulative implant survival rates in the present study were 98.6%, with rates of 98.4% for implants with an insertion torque value < 35 Ncm and 98.7% for implants with an insertion torque value ≥ 35 Ncm. The outcome was comparable with those of other studies. In a recent study, a total of 1,903 implants were placed in 441 immediately loaded fixed prostheses. On average, 4.3 and 4.1 implants were placed in the maxilla and mandible, respectively. The overall implant survival rate was 98.1%. The corresponding implant survival rates for insertion torque values ≥ 35 Ncm, 15 to 34 Ncm, and < 15 Ncm were 98.2%, 98.4%, and 96.3%, respectively. In another study, 322 implants were inserted (120 with an insertion torque value of < 30 Ncm and 212 with an insertion torque value of ≥ 30 Ncm) in the maxilla using the All-on-4 treatment concept. The cumulative implant survival rate was 98.4%, with rates of 98.3% and 98.4% for implants with insertion torque values < 30 Ncm and ≥ 30 Ncm, respectively. Although
implants with a low insertion torque value had a successful outcome similar to implants with an insertion torque value > 30 Ncm, during the healing period, the occlusal schemes for implants with low insertion torque were not particularly highlighted in either of the aforementioned articles.

Due to the peri-implant mucosal defect, two implants that were intentionally removed were recorded as failures instead of occlusal overload. The cumulative implant survival rate was slightly better than that revealed in another study employing the same arrangement of numbers of implants per arch: Tealdo et al treated 21 patients, who received four to six immediately loaded implants with an insertion torque value of 40 Ncm each to rebuild the maxilla. Their cumulative implant survival rate was 92.8% at 12 months. An occlusal scheme was set with group function on the working side with minimization of nonworking side interferences and no cantilevers distal to the distal implants. During the first 3 months, eight implants failed, five of which were distal angulated implants. Two of the failed implants were shorter than 13 mm.

Different occlusal schemes were adopted in provisional immediately loaded full-arch implant prostheses. No distal cantilever force was suggested by many authors. Hinze et al used a minimum of 10 units supported by posterior tilted implants. Agliardi et al limited occlusion in the intercanine zone, regardless of the centric contact or lateral contact. Maló et al adopted anterior occlusal contacts and canine guidance during lateral excursions. Collaert and De Bruyn equally distributed the occlusal load on 10-unit provisional prostheses with seven to nine implants and gave no dietary restriction instruction to patients.

Although splinting multiple implants with a strengthened provisional prosthesis can offer extra stability to each implant, occlusal overload might compromise the outcomes. Nevertheless, limited scientific evidence regarding occlusion in immediately loaded fixed prostheses was collected. Kumagai et al investigated occlusal force distribution on natural dentition using different clenching strengths. They concluded that the distribution of the occlusal force was greatest at the posterior region in the dental arch. In a recent study using a finite element analysis (FEA) of the All-on-4 treatment concept, greater stresses were distributed at the posterior region of the implants and bones. Stress values on load-bearing structures were lower in the canine-guided occlusion than in other occlusal schemes. In this occlusion type, occlusal force and stress values were low during prosthetic movement, in which tooth contact occurred only at the incisors. To the best of the authors’ knowledge, this was the first description of the application of different occlusal settings based on the distribution of implants with low insertion torque.

In this study, anterior occlusal contacts were adopted in groups 1 and 2 to minimize the stresses at the posterior region during the healing period. Although canine-guided occlusion was preferred, provisional all-acrylic prostheses were sometimes associated with prosthetic complications, eg, resin tooth debonding, resin tooth fracture, and denture base fracture. Wie also found that canine-guided occlusion posed stress concentration on the canine area, which raised the possibility of screw joint complication at this site. To prevent prosthetic complications, only single tooth contact should be avoided during protrusive movement and lateral movement during the initial healing stage.

In group 3, secured implants distributed equally in the anterior region were not available, or the majority of the implants inserted had an insertion torque value < 35 Ncm. Both situations were unfavorable. The occlusal setting was to distribute the occlusal force equally without occlusal contact on implants with relatively low insertion torque. This occlusal scheme could provide extra mutual protection for implants with low insertion torque by splinting implants in a fixed solid prosthesis. In such unfavorable cases, splinting implants using prostheses with rigid frameworks can provide additional biomechanical stability. A previous study evaluated stress distribution on three types of fixed prostheses supported by four implants through a 3D FEA model. The greatest stress values on the implant, bone, and prosthesis were observed in a full-acrylic denture without a framework, whereas the lowest stress values were observed in a denture with a cast metal framework. The carbon fiber framework presented intermediate behavior. Degidi et al evaluated immediately loaded full-arch prostheses supported by six to seven implants in 13 patients. The provisional prosthesis reinforced by an immediate intraoral welded bar technique resulted in a 98% survival rate for implants with < 20 Ncm torque. Meanwhile, meticulous dietary instructions were given to the patients. The implant survival rate appeared to be highly related to the patients’ compliance with dietary practice.

Among the three groups, the primary stability of the anterior implants played an important role in the outcomes of the immediately loaded full-arch fixed prostheses. Jensen and Adams also emphasized this perspective in their article. In the scenario of a provisional denture supported by four implants in group 3, this unfavorable distribution might be remedied by inserting an extra anterior implant.

Furthermore, a systematic review investigated the relationship between the insertion torque value and marginal bone loss and showed no significant difference in marginal bone loss between implants with high (≥ 50 Ncm) and low-to-moderate (< 50 Ncm) insertion torque values. However, most implants included in...
these articles were single implants without immediate loading. The present study did not investigate marginal bone loss in immediately loaded implants. More investigations are required to evaluate the relationship between insertion torque value and marginal bone loss in full-arch fixed prostheses supported by immediately loaded implants.

Implants with low insertion torque have different occlusal settings implemented according to their number and distribution position. The purpose is to reduce the occlusal force that implants with low insertion torque bear during the healing period; thus, they could heal with other more stable implants without affecting the overall outcome. However, patients still have to cooperate with other supporting measures that should be needed, such as a soft diet.

The present study results encouraged the use of this occlusal setup for implants with low insertion torque in immediately loaded fixed prostheses. However, minimizing the number of implants with low insertion torque was required. Nevertheless, given the nature of the present study and the complex system of the full-arch fixed prostheses supported by immediately loaded implants, future studies are warranted to investigate the effect of individual factors to confirm these results.

CONCLUSIONS

The proportion of implants with low insertion torque values in the maxilla was greater than in the mandible. Implants with low insertion torque values were not associated with specific tooth positions or anterior/posterior regions. Implant length had no significant association with an insertion torque value. Implants with a 3.3-mm width had a greater proportion with a low insertion torque value than implants with a 4.0-mm width. Immediately placed implants were significantly associated with an insertion torque value > 35 Ncm. The cumulative survival rates of implants with an insertion torque value < 35 Ncm were comparable with those of implants with an insertion torque value ≥ 35 Ncm in immediately loaded full-arch fixed prostheses. Much effort is needed on the occlusal setup of implants with low insertion torque in immediately loaded full-arch fixed provisional prostheses to ensure the outcomes.

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REFERENCES


