A successful protocol for immediate loading (IL) of multiple implants depends on an adequate fixation and immobility of the implants to prevent the risk of micromovement in the surrounding bone (1). Osseointegration or fibrous encapsulation is directly related to the micromovement of immediately loaded implants (1). It has been shown that cross-arch splinting is critical for the success of IL since it reduces the micromovement and the mechanical stress exerted on each implant (2).

The immediate loading protocol involves both surgical and restorative phases. This is a complex procedure requiring implant provisionalization on the day of the surgery. Therefore various techniques have been introduced to make this procedure less technique sensitive, less time consuming, more accurate and more predictable (3). These included computer guided surgery, laboratory processed provisionals, use of an omnivac shell to fabricate cement retained provisionals, use of angled abutments and use of temporary abutments to adjust the angulation during provisionalisation (2, 3). The latter of these techniques would not be necessary if implants were placed in optimal position and angulation with proper interimplant distance (4). However there is paucity of literature discussing how to obtain optimal buccolingual and mesiodistal parallelism of immediately loaded implants.

The purpose of this case series was to demonstrate an innovative paralleling device and a step by step surgical and prosthetic approach for achieving buccolingual and mesiodistal parallelism of immediately loaded implants. Clinical outcomes including success rates, indications, advantages, complications, and limitations of this technique in cases using an immediate loading protocol will be discussed.

MATERIAL AND METHODS

Clinical data in this study was obtained from the Implant Database (ID). This data was extracted as de-identified information from the routine treatment of patients at the Ashman Department of Periodontology and Implant Dentistry at the New York University College of Dentistry (NYUCD) Kriser Dental Center. The ID was certified by the Office of Quality Assurance at NYUCD. This study is in compliance with the Health Insurance Portability and Accountability Act (HIPAA) requirements and approved by the University Committee on Activities involving Human Subjects.

Thirteen consecutive cases from the database that were treated with an IL protocol utilizing a the paralleling device were included in this study. The treatment sites included the interforamina area in 8 totally edentulous and 5 partially edentulous mandibles.
Patient Inclusion Criteria:
All of the included patients had:
1) A total of 3-6 implants placed and immediately loaded on the same day of the surgery with a chair-side provisional restoration.
2) Totally edentulous mandible or partially edentulous mandible with more than 5 teeth that required extraction in the anterior mandible due to periodontal disease, fracture or failure of endodontic treatment.
3) An adequate anterior-posterior (A-P) spread that was present in the lower arch.

Patient Exclusion Criteria:
All patients that were excluded from the study had:
1) Systemic diseases that could alter the tissue integration of dental implants.
2) Generalized active periodontal disease or active periapical infection in the remaining teeth.
3) Parafunctional habits.
4) Lack of compliance.

Clinical Procedures:
For all included patients, the clinical procedures were standardized and included the following steps:
1) Clinical and radiographic examinations were made (Fig 1, 2).
2) Pre-surgical steps – Vacuum form shells and resin shells fabricated from an ideal wax up or pre-existing denture, and a bite registration on the occlusal surface of the shell with pattern resin (GC corporation, Tokyo, Japan) to evaluate the vertical dimension of occlusion.
3) Subjects took 2 g Amoxicillin (TEVA, USA) 1 hour prior to surgery and in those allergic to Penicillin, 600 mg of Clindamycin (Pharmaderm USA) was given.
4) Mid-crestal and when necessary vertical incisions were made after local anesthesia infiltration (2% lidocaine 1:100000 epinephrine (Henry Schein USA)).
5) Atraumatic tooth extraction took place in cases where immediate implant placement was performed (Fig 3).
6) Full thickness mucoperiosteal flaps were reflected.
7) Alveoplasty was performed in cases where the alveolar ridge required contouring after extraction (Fig 4).
8) A total of 3-6 implants were placed in each mandible using an adjustable paralleling device (Fig 5). The implant placement utilizing an IL protocol featuring implant surfaces with either a resorbable blast media (RBM) or Sand-blasted, Large grit, Acid-etched (SLA) surface in the endosseous portion. A crestally widened implant platform diameter of 4.8 mm, a body diameter of 3.3 or 4.1 mm and a length of 12 or 13 mm (Sybron XRT, Orange, CA, Straumann Standard Plus, Basel, Switzerland) was used. Primary stability of each implant was achieved by undersizing the osteotomy and engaging a widened crestal platform of the implant with the cortical bone. This meant that the 2 different types of implants were placed differently. The RBM surfaced implants were placed 2 mm more apical than the roughened surface in order to engage the widened neck with the crestal bone. Primary stability of more than 30 Ncm was confirmed for each placement using a torque driver (Fig 6).
9) The narrow diameter abutments (platform switching concept) were connected at a torque of more than 30 Ncm and wound closure was achieved using 4.0 resorbable sutures (vicryl ethicon) (Fig 6, 7).
10) A fixed provisional restoration was fabricated chair-side for cross-arch stabilization. The omnivac shell or resin shell (Fig 8) was mounted to verify that the abutment fit in the template. Prefabricated plastic copings (Fig 9) were placed on the abutments and a self-curing acrylic resin or Bis-acryl Luxatemp (DMG, Hamburg, Germany) was then injected into the template. The template was seated with bite registration and guidance from adjacent teeth and/or the opposite jaw, and allowed to set for 4 minutes while the patient was biting in maximum intercuspation. After the
temporary prosthesis was removed from the abutment, excess material was trimmed outside the mouth and occlusion adjustments were made.

11) The provisional restoration was luted with Polycarboxylic cement (Durelon 3M ESPE, Norristown, PA) and all implants were immediately loaded in function.

12) The patient presented for postoperative care at 1 week, 2 weeks and then once every month following implant placement to monitor oral hygiene, mucosal healing, the stability of the provisional bridge, and fixture status. The patients were instructed to follow a soft diet for 6-8 weeks after surgery. Each patient was prescribed antibiotics (Amoxicillin 500 mg TID or Clindamycin 150 mg QID) and Chlorhexidine gluconate for 1 week following the surgery.

13) The provisional prosthesis was not removed to avoid an excess of macromovement until the healing period was completed. Follow up panoramic radiographs were taken.

14) After 3 months of healing period, the provisional restoration was removed to evaluate implant mobility and peri-implant soft tissue.

15) The definitive prosthesis was fabricated after a final impression was obtained 3-6 months after implant placement (Fig 10, 11).

RESULTS

In this case series the average survival rate was 98.4% with a loading period of 6-28 months. There was one implant failure, one provisional restoration fractured and two cases with cement wash out during the follow-up period (Table 1).

DISCUSSION

The IL of implant-supported fixed prostheses is clinically well documented with a reported 85.7-100% implant survival rate in the edentulous mandible (2-13). Immediate implant placement and loading with fixed prostheses shows a 97.7-100% implant survival rate in the mandible (14,15). The results of the present study indicate similar implant survival rates. In this case series, a total of 63 implants were placed in 13 patients using the paralleling device and all immediately loaded. The average survival rate was 98.4% with a loading period of 6-28 months. Primary stability of more than 30 Ncm of torque was achieved by undersizing the osteotomy and engaging the widened crestal platform of the implant with the cortical bone. There was one implant failure, one provisional restoration fractured and two presented with cement wash out during the follow-up period. However in all cases the prosthesis was maintained in place during the first 2-4 months of the healing phase.

It has been reported that the critical factors for successful IL are implant stability upon insertion and cross arch splinting via a rigid implant supported bridge to decrease micromotion less than 50-150 nm at the bone–implant interface (16). If three or more implants are placed in a tripod or a cross-arch configuration, splinting a provisional bridge as soon as possible after implant placement reduces lateral forces on implants and allows more favorable axial forces (2, 17, 18).

Other critical factors for implant success are achieving optimal implant position and angulation. Creating a flat bony contour (shelf) is the initial step to establish optimal implant position and angulation as well as to define anatomy to maximize implant fixation for immediate load prosthesis (19). This osteoplasty creates a flat shelf on which the restoration is placed. The shelf serves multiple functions for both the surgeon and the prosthodontist. These include:

1. Establishing prosthetic restorative space
2. Establishing a level alveolar plane and uniform implant levels
3. Establishing alveolar width for
implant diameter selection
4. Bone reduction makes basal bone accessible for implant fixation
5. Helps to establish arch form, implant distribution and anterior posterior spread
6. Identifies optimal implant sites

In the mandible segmental hyper eruption of the ridge is a common finding. The ridge contouring bur is used to contour the ridge and establish a shelf which helps implant placement at the same level and helps establish a prosthetic platform.

Optimal implant position in terms of ideal inter-implant distance can be achieved if the implant is placed in the tooth position. This can be done by using a surgical guide which is made from an ideal wax up that is prepared presurgically. However implant placement also depends on the anatomy and morphology of bone and sometimes implants cannot be placed in the ideal tooth position due to lack of bone availability.

After the position of the implant has been identified, the direction/inclination of the implant must be determined. Establishing mesiodistal and buccolingual parallelism during implant placement is an important step. Mesiodistal parallelism can be achieved using a surgical guide or the paralleling device (Fig 5). However achieving ideal buccolingual parallelism between multiple implants during placement is difficult. Adverse directions can impair the esthetics and function of the future restoration. Angulated abutments may to some extent compensate for such surgical shortcoming. Therefore, when using an IL protocol every attempt should be made to keep implant positions and angulations within ideal prosthetic contours as special components that correct poor angulation or position are usually not readily available.

Temporization in IL can be accomplished using different techniques. These include use of an omnivac shell to prepare chairside cement retained provisional, use of a premade resin shell to fabricate a cement-retained provisional, use of lab processed provisional or conversion of an existing denture into a screw-retained provisional (3, 4). Since the late 1990’s, cement-retained restorations have been the preferred method with high success rates while aiding IL restorative time reduction (20, 21). Screw-retained restorations are more technique sensitive and time consuming when fabricated chair-side. Moreover, cost is increased due to the additional laboratory and clinical components, and it is difficult to obtain non-passive bridgework (22). Parallel alignment avoids use of angled abutment or abutment adjustment (23). Bony stress is concentrated in the cervical area of an implant, therefore cervical cortical bone serves as the major anchoring point for an implant (2, 24). Parallel implant placement also reduces the stresses at the implant and bone interface since the implant does not have a PDL which acts as a shock absorber in teeth. A midline guide pin and a paralleling device may be used to obtain good parallelism. Other factors for successful provision-alization with an IL protocol include careful cementation. A permanent cement is recommended because the prosthesis must remain fixed during

### Table 1. Results of the study

<table>
<thead>
<tr>
<th>Pt</th>
<th>Type</th>
<th>Opp</th>
<th>Manufacturer</th>
<th>Implant</th>
<th>Size (mm)</th>
<th>Follow up (mo)</th>
<th>Survival Rate (%)</th>
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<td>CW (3mo)</td>
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<td>Sybron</td>
<td>4</td>
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<td>13</td>
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<td>CW (3mo)</td>
</tr>
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the first 8 to 12 weeks post-surgically otherwise implant stability and osseointegration may be compromised. Additional care must be taken to limit cement extrusion beyond the abutment restoration margin, and into the peri-implant mucosal tissues because residual cement may cause inflammation and compromise bone and soft tissue healing (25, 26).

CONCLUSIONS

Results of this case series demonstrated that implant placement in optimal position and angulation using the suggested IL protocol and paralleling device produces predictable results. It is also simpler, faster and more cost effective than the screw-retained protocol. Nevertheless, future prospective studies with long-term follow-up and an increased number of cases are necessary to further evaluate this technique.

REFERENCES

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