



Immediate function with dental implants

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Immediate function or immediate loading is defined as the placement of a dental implant fixture, abutment and functional (provisional) restoration all at stage one surgery. The abutment and restoration is placed into "limited" function within the first 48 hours and allowed to osseointegrate during the ensuing months.

This concept of immediate function has become an accepted alternative for complete arch fixed restorations in the mandible and clinical documentation is emerging for other indications as in single tooth and partially edentulous spaces.

The benefits of "Immediate Function" are shortened treatment time, better clinical efficiency and less trauma to the patient - it is now possible to go from suffering from tooth loss to having functional and aesthetic teeth in one treatment session.

There are advantages and disadvantages with the use of the immediate loading concept as outlined below:

Advantages:

- Decreases treatment time;
- Improved patient comfort;
- No transitional prosthesis. i.e. denture, bonded bridges;
- Limits unwanted exposures and maintains gingival contours;
- Minimises number of surgeries;
- Less trauma to soft and hard tissues;
- Cost savings to patient and doctor;
- Improves acceptance rates for treatment; and
- Psychological benefit to the patient.

Disadvantages:

- Clinically demanding;
- Generally cannot be undertaken when guided bone regeneration is required;
- Provisional crown - single tooth, partially edentulous bridge should be out of occlusion in centric and free in lateral movements;
- Requires good bony support and implant stability; and
- Strict patient compliance required.

Bone physiology

The physiology that occurs during the process of osseointegration is similar to what occurs in bony healing or regeneration. Schenk and Hunziker outlined this in 1994, summarized in different phases as:

- Angiogenesis - blood vessel infiltration;
- Osteoprogenitor cell migration;
- Woven bone scaffold formation, which occurs at 30-50 μ a day;
- Deposition of parallel fibered or lamellar bone; and
- Secondary bone remodeling.

The implant-bone interface is weakest at 3-6 weeks after implant insertion as the interface is unorganized and least mineralized at this time. Under optimal conditions, it was demonstrated that six weeks after implant placement, lamellar bone was present at or near the implant surface. At four months, the bone is still only 60% mineralized, organised lamellar bone. In reality, the bone interface is stronger on the day of implant placement compared with three months later. The biological strength (osseointegration) increases from 4-6 months.

Therefore with the immediate function concept, once the implant is inserted it is advisable not to perform any prosthetic procedures after the temporary has been placed. It is important to keep the occlusion light or with no contacts, especially lateral forces for at least three months.

Success rates

Most of the clinical studies on "Immediate Function" are short-term, but it is believed that after the first year of function and bone healing, the prognosis is the same as for the two-stage approach.

Completely edentulous: Over the last few years, authors have reported on immediate loading in the completely edentulous patient with 95-100% success rates. A review of the literature shows that the majority are mandibular cases, however, there are publications also of maxillary

cases. The cumulative survival rate varies between 80-100%, with the majority reporting between 95-100%.

Examples include: Novum; "Teeth in an hour" protocol; "All on Four".

Single Tooth and partially edentulous:

The cumulative survival rates with immediate loading ranges between 81% and 100% with the majority once again between 95-100% comparable to the results with conventional and early loading protocols.

Immediate loading from initial reports in the literature show similar success rates to a 2-stage approach for both single tooth, partially edentulous and completely edentulous patients. Gapski et al in 2004, in a critical review of immediate implant loading, discusses that primary stability is the key factor in immediate loading with several other factors influencing the outcome. These are surgery, host, implant and occlusal related factors.

Surgery Related Factors

1. Primary implant stability: micro-movements of more than 100 μ m endanger osseointegration and may allow fibrous encapsulation of the implant.

2. Surgical Technique: gentle technique with generous irrigation is required when preparing the osteotomy site. If the temperature of the bone rises over 47°C for one minute, this can cause heat necrosis. Other factors - amount of bone prepared, drill sharpness and depth of preparation, cortical thickness.

Host related factors:

1. Bone quality and quantity: implant placed in compact dense bone has more initial stability and higher success rates for immediate function. As discussed with immediate function, firm initial stability is of utmost importance. This can be achieved with tapered implants and/or under-preparation techniques for the parallel wall implants.

“The most important factor in immediate function is the high initial implant stability... and controlling the occlusal forces during healing...”

2. Wound healing: metabolic diseases like osteoporosis, diabetes, hyperparathyroidism, smoking, patients who have undergone radiation therapy, have a lower wound healing and there has been a suggestion to follow 2-stage protocol for these patients.

Implant related factors

1. Implant design/configuration: screw implant design has higher mechanical retention plus the ability to transfer compressive forces better.

2. Implant surface coating: rough surfaces have a higher bone-implant contact. E.g. TiUnite, SLA, HA.



*Fig 1.
Replace Select implant
with TiUnite surface.*

3. Implant length: the longer the implant the more stability there is. A 50% failure rate with immediate loading of lengths less than or equal to 10mm was reported by Schnitman et al 1997. This may be not as relevant now with the introduction of roughened implant surfaces and the higher surface area there is for integration.

4. Tapered implants have shown to be better in softer bone, eg Replace Select, Branemark Mk IV.

Occlusion related factors

1. Quantity and quality of force: controlled functional forces essential in immediate loading. Vertical forces are less detrimental to implant stability than oblique or horizontal forces. Therefore in immediate function, care must be taken with the occlusal scheme chosen and it is advisable to keep single tooth and partially edentulous cases free from occlusion.

2. Bruxism is a major contraindication to immediate loading due to higher failure rates associated with bruxers.

3. Prosthetic design - primary stability enhanced when cross-arch splinting is performed for completely edentulous patients. Multiple implants may be better splinted together.

Prerequisites for Immediate Function

- High initial implant stability - bone quality and quantity will influence stability. Tightening insertion torque of 35Ncm or more.

- Controlled loads - minimal function on the healing implant.

- Osseointegrative implant surfaces - TiUnite surface supports the healing process and prevents loss of stability during healing. Other surfaces include SLA, HA.

- Occlusion - no contact in centric or laterotrusion. Special care is recommended when it comes to evaluating load distribution and the elimination of cantilevers and lateral forces. If possible, the occlusal contact should be reduced during the first 2-3 months after implant placement.

- Light interproximal contacts for single teeth - let floss go through (no indirect movement from adjacent teeth).

- Splint adjacent implants if multiple implants are placed.

- Tighten screws - loose prosthetic screws can create more problems.

- Modify diet - this should be limited to soft foods during the immediate loading process. Food such as pasta or fish is recommended while hard breads, steaks, hard nuts are contraindicated.

- No pronounced bruxism.
- Do not remove provisionals for three months.

The most important factor in immediate function is the high initial implant stability with a tightening torque of greater than 35Ncm and controlling the occlusal forces during the healing period. The use of osseointegrative implant surfaces is another factor shown to support the healing process and prevent loss of implant stability during healing.

Resonance Frequency Analysis

The use of resonance frequency analysis with instruments like Osstell™ provides a way to clinically measure implant stability and osseointegration (Meredith 1997). Recent findings with Osstell™ shows that it can be used as a diagnostic method to optimise implant treatment with regard to healing periods, type of prosthetic construction and surgical protocol (1- vs 2-stage).

The technique is contactless, totally non-invasive and patients experience no sensation from the measurement, which

takes 1-2 seconds. Stability is displayed as an ISQ-value by the instrument. This value (Implant Stability Quotient) is derived from the resonance frequency of the peg, which in turn depends on the stability of the implant. ISQ is scaled from 1 to 100; the higher the ISQ, the more stable the implant. There has been early reports that immediate function is possible if the ISQ is 60 or above. Further study into this diagnostic tool is warranted.

Low RFA levels after 1 and 2 months seem to indicate an increased risk for future failure. This information may be used to avoid implant failure in the future by unloading implants with decreasing degrees of stability with time as diagnosed with the RFA technique.



*Fig. 2:
Ostell Mentor -
resonance frequency
analysis*

Surgical procedure (Immediate Loading)

The same principles apply as per normal implant placement procedures. For an implant to be considered for immediate function, it should be able to withstand 35-45Ncm without further rotation, i.e. measured by the surgical unit or a manual torque wrench.

With placement of implants, this can be at the time of extraction as in “immediate placement, immediate loading” or placed into healed sites “delayed placement, immediate loading”.

G. Chaushu et al (2001) with 26 patients studied the clinical success of immediately loaded single-tooth implants placed in fresh extraction sites to that of immediately loaded single-tooth implants placed in healed sites.

The survival rates were 82.4% and 100% for immediate and non-immediate implants. Immediate loading of single-tooth implants placed in fresh extraction sites carried a risk of failure approximating 20% in this patient population. Care must be taken if immediate placement and immediate loading are to be completed in a single visit procedure due to this reported lower success rate.



Fig 3. Implant placement into healed site. Replace Select implant with Easy Abutment.



Fig 4. Occlusal View: access covered with cotton wool pellet and Cavit.



Fig 5. Try-in Polycarbonate crown, to be relined internally.



Fig 6. Completed temporary crown issued for immediate function.



Fig 7. Immediate Placement, Immediate Loading, careful tooth removal with Periostomes and Luxators.



Fig 8. Socket checked with periodontal probe to verify integrity of bony plates.

Prosthetic Options

Single tooth/Partially edentulous: Final abutments or temporary abutments can be placed at time of implant placement depending on the clinician's choice. It is the authors practice to use temporary abutments in the aesthetic region for the healing period followed by final abutments chosen once the

implant has osseointegrated and soft tissues have stabilised.

Provisionalisation can be performed in many different ways from the use of a polycarbonate crown, standard acrylic or BIS-GMA composite temporaries, e.g. Lux-atemp that is customized chairside to fit the abutments. The other option is a laboratory manufactured temporary crown. This can be

made with registration at Stage 1 surgery, the temporary crown constructed and then issued same day or within 48 hours.

It is important to have a smooth contour and correct emergence profile on the provisional crown to allow guided healing and care must be taken with all materials and cements not to contaminate the surgical site. Figures 3-14 illustrate the process.

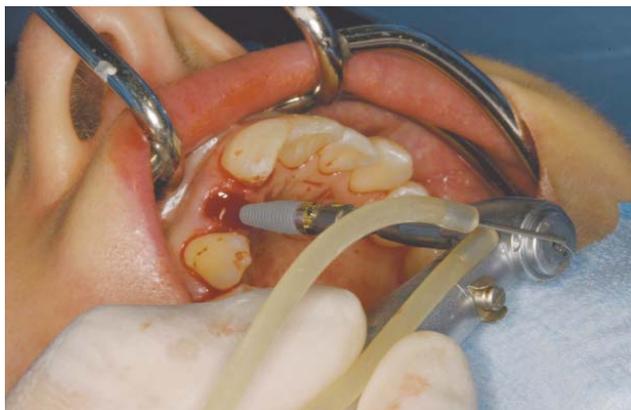


Fig 9. Implant inserted with insertion torque greater than 35Ncm.



Fig 10. Registration of implant at placement with hydroplastic "TAK" material for lab processed temporary crown.



Fig 11. Laboratory-made temporary crown is issued same day or next day. Healing is allowed for greater than 3 months.



Fig 12. Occlusal view of temporary crown, access hole to be filled with cotton wool pellet and temporary restoration.



Fig 13: Note in lateral movements, no occlusal contacts of the temporary crown.



Fig 14: Final Crown placed four months later - day of insertion.

Fully Edentulous: There are two options for temporising a full arch fixed bridge:

Denture conversion technique: This is the author's favoured technique. The existing denture or a duplicate diagnostic denture, which has been optimized for aesthetics, function and vertical dimension. The denture is con-

verted by cutting out a section of the denture where the impression copings will fit (either closed or open tray copings) (Fig 17). This is then indexed with impression material and resin pattern (GC Resin Pattern) or Duralay (Fig 18) and then the denture is processed and converted to become a transitional fixed prosthesis (Fig 19). No posterior can-

tilers are fabricated for the transitional restoration when they are out of the aesthetic zone (Fig 20).

Conventional technique: The surgical appointment and prosthesis delivery appointment is split into several appointments. Implants are placed as above, but then the dentist records vertical dimen-



Fig 15. Immediate loading of completely edentulous mandible with the denture conversion technique. Patient with five Branemark implants placed interforamina with multi-unit abutments.



Fig 16. Temporary cylinders placed on multi-unit abutments.



Fig 17. Denture hollowed out to allow temporary cylinders to be indexed to denture.



Fig 18. GC resin pattern linked to temporary cylinders and denture.



Fig 19. Denture modified and a transitional fixed prosthesis is issued to patient for immediate function.



Fig 20. Note distal cantilevers kept to a minimum.

sion of occlusion and centric bite and takes impressions of the implants followed by placement of healing abutments as a one-stage approach. The laboratory then fabricates the transitional prosthesis with possible try-ins and depending on the lab, within a few days should have the prosthesis delivered to the patient.

Conclusion

The benefits of “Immediate Function” are shortened treatment time, better clinical efficiency and less trauma to the patient - with the ability to have functional and aesthetic teeth in one treatment.

Most of the clinical studies on Immediate Function are short-term, but it is believed that after the first year of function

and bone healing, the prognosis is the same as for the two-stage approach for single tooth, partial and completely edentulous cases.

Nonetheless these findings do not imply that a submerged and/or delayed approach may not be necessary in certain situations. Future studies based on looking at host, implant, surgical and occlusal factors may

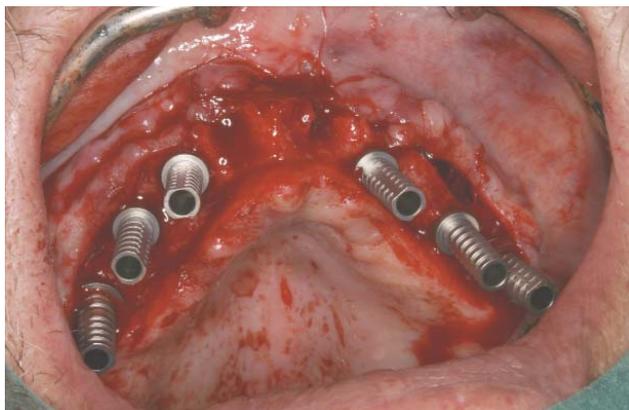


Fig 21. Maxillary immediate function with six Replace Select implants. Temporary cylinders at implant placement ready for indexing.



Fig 22. Denture modified and contoured to become a fixed prosthesis.



Fig 23. Issue fixed prosthesis from modified denture.



Fig 24. Occlusal view: Screw holes to be filled with temporary material.

find the ultimate indication for immediate function. In general, most publications indicated that with attention to appropriate factors, implant survival with immediate restoration was comparable to the results with conventional and early loading protocols. It should be recognized that these conclusions may be misleading, as most publications were written by exceptionally experienced, highly skilled practitioners working under tightly controlled clinical conditions on a relatively small, statistically inconclusive number of implants and patients.

It is the responsibility of each clinician to weigh up the benefits and risks of immediate function for each patient and implant site and there are often situations that call for delayed loading or a return to the original 2-stage protocol.

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