Full arch rehabilitation after failure of implants and teeth supporting an extensive fixed dental prosthesis: a staged approach

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Abstract
The present clinical report describes the treatment strategy for transition from full-arch restorations supported, either partially or fully supported by failing implants that need to be removed. More specifically, the staged approach proposes a deferred treatment sequence in which the failing implants or teeth are not all replaced simultaneously. On the contrary, according to this technique, some failing natural or artificial abutments are preserved momentarily in order to maintain the patient with a fixed provisional restoration at all times throughout the execution of treatment, from the surgical phases until delivery of the final restoration. The present clinical report describes the staged approach in detail, compares it to other treatment options and illustrates all phases of therapy with a clinical case. Int J Prosthodont 2021. doi: 10.11607/ijp.6718

Introduction
Success rates of dental implants in the short- and long-term are high. However as treatment with dental implants increases and becomes more commonplace, the rate of complications is also steadily increasing.

In full arch implant supported restorations biological complications, namely periimplantitis, range between 20.1% at 5 years and 40.3% at 10 years³. Technical complications in implant supported fixed dental prosthesis (FDP) occur in 25.1% of cases at 5 years depending on the various reports². In cases of extensive (full arch) fixed implant supported rehabilitations complications around 24.6% are reported¹. It should be noticed that multiple implant failures may occur in few individuals, (the so-called cluster effect) and thus the clinician may be faced with an extensive restoration supported by multiple failing implants³.

The treatment of biological complications resulting in bone loss and peri-implant defects is performed with various approaches including hard tissue grafting, resective therapy,
Implantoplasty or a combination of all three procedures. Unfortunately, the success rate of these procedures is unpredictable and recurrence of biologic complications occurs in a high percentage of cases, as do disease progression and lack of disease resolution. Consequently, in certain situations implant removal is unavoidable.

Other reasons for implant removal are malpositioned implants restored with functional or esthetic compromises due to a non-ideal prosthesis, or implant fracture. Furthermore, when treatment results in an esthetically unsatisfactory outcome, the patient may prefer to remove the implant.

Implant failure or removal often causes extensive peri-implant bone loss. The resulting defects, necessitate extensive bone grafting procedures.

When the implants that need to be removed support a full arch fixed restoration the treatment becomes more challenging in terms of management of the interim restoration and of the requested bone augmentation procedures. This is true also in the case of a prosthesis with a mixed tooth and implant support where there are hopeless teeth and implants.

If an implant supported restoration is the final goal of the treatment, many strategic decisions lie ahead. The clinical steps will include removal of abutments with a poor prognosis (either implants or teeth), delivery of a provisional prosthesis which can be either fixed or removable, insertion of new implants (in combination with augmentation procedures if necessary) and completion of the final restoration.

Different timings may be selected to perform the aforementioned treatment steps. The described clinical situation is somehow similar to the treatment of a hopeless (or irrational to treat) dentition that needs to be converted into a full-arch implant supported restoration. In this clinical situation some authors have proposed a staged approach that allows the use of a stable fixed provisional restoration throughout the treatment phases without the need of immediate placement and immediate loading procedures. However, few reports have described integrated surgical and prosthetic protocols in the case of multiple failing implants.

This paper aims to describe a method of transitioning the patient from hopeless restorations supported mainly by failing or irrational-to-treat implants to a fixed implant-supported full-arch restoration without the use of a removable provisional restoration. The treatment rationale is based on removing and replacing the failing abutments in a staged sequence so as not remove the failing abutments until the newly placed implants may be loaded.

**Rationale for a staged approach when failing implants and or natural abutments supporting a full arch FDP are considered irrational to treat.**

It is not the purpose of this paper to describe guidelines for implant removal or tooth extraction.
When a full arch FDP is failing and all available abutments in the arch are considered unreliable, the clinician has several treatment options if the treatment goal is a new FDP:

- **Conventional approach:** explantation/tooth extraction and subsequent implant placement at least 6-8 weeks later. In this case a removable provisional restoration is needed. (ITI type 4B, 4C)

- **Immediate implant placement:** placement of the implant at the time of implant or tooth removal (if adequate socket morphology is encountered after extraction) (ITI type 1B, 1C)

This approach is well documented when teeth are to be extracted, but only few papers report on immediate implant placement after implant removal. Immediate implant placement after extraction of a tooth can be performed under specific conditions. Ideal results are met when the implant can be placed in the correct tridimensional position and achieve primary stability. Furthermore the buccal plate should be well-represented. Moreover if implant malpositioning is the cause of implant removal, insertion of a new implant in the same site but with correct tridimensional positioning is rarely possible.

- **Immediate implant loading:** immediately loading the implants placed in healed sites (after ridge healing) with a full-arch restoration (ITI Type 4A, 2-3A).

In this approach a removable prosthesis is needed after implant or tooth removal prior to implant placement. Minor bone augmentation procedures, if needed, may be performed at the time of implant placement without the inconvenience of pressure on the augmentation site caused by the removable prosthesis. Evidence in the literature supports very high survival rates when primary stability can be achieved at the time of implant placement.

- **Immediate loading of immediate implants:** this approach ideally consisting in removing the failing implants replacing and loading them in the same surgical-prosthetic phase has not been described so far (ITI Type 1A).

- **Staged approach.** Includes multiple treatment phases, early or late implant placement after selective implant or tooth removal, the use of a fixed provisional restoration throughout the treatment temporarily supported by some of the failing abutments, and early implant loading protocols.

Table 1 shows possible treatment options in cases of transition from a failing extensive implant supported restoration. The definition of interval from extraction and loading times are the ones proposed in the ITI consensus 2018 (Galluci et al 2018)

The staged approach involves several treatment steps:

- **Diagnosis:** Often the final prognosis of all abutments may be decided only after removal of the failing prosthesis. It should be noted that not all full arch restorations are retrievable without causing damage to the FDP itself. The fabrication of a provisional fixed restoration is advised, Radiographs with an appropriate angulation are essential for a proper diagnosis and
whenever possible, it is helpful to compare with baseline and previous radiographs of the reconstructions. In certain cases it may be advantageous to obtain a CBCT in order to visualize the buccal bone\textsuperscript{14}, even though cross sectional imaging may be postponed to a further phase (i.e. after tooth/implant removal).

- **Treatment planning:** once the condition has been correctly diagnosed, and all the conservative treatment options have been carefully evaluated for the teeth and implants, the clinician must decide whether the prosthetic pillars should immediately be explanted/extracted or temporarily retained. In the staged approach it is essential to maintain some provisional abutments either natural or artificial, that will serve to support the provisional prosthesis.

The choice of the pillars that will initially be maintained is crucial and is mainly based on two factors:

A) The clinician will choose abutments that guarantee (at least for few months) retention of the provisional restoration and reasonable prognosis in terms of recurrent acute peri-implant or periodontal infection. The cross arch distribution of these pillars has to be carefully evaluated since they will support the provisional fixed restoration.

B) Extractions or implant removal will result in edentulous areas for the new implants to be placed, so the clinician should carefully consider the final implant distribution at this stage. In this respect, sound prosthetic principles should guide the planning: avoiding adjacent implants if possible, evaluating the extension of cantilevers and pontics, allowing for a reasonable number of implants to support the final restoration, if possible planning for a segmented restoration.

Often the clinical situation calls for some compromise in regards to the aforementioned conditions. In this case the need to maintain a fixed provisional restoration is the priority and may justify some minor prosthetic compromises in the final restoration.

The treatment phases are briefly described and reported in Table 2.

1. Periodontal causal therapy aiming to achieve resolution or significant improvement of inflammatory processes
2. Prosthesis removal combined with strategic extractions/explantations and delivery of a fixed provisional restoration
3. Re-evaluation of the local conditions including residual bone anatomy, periodontal and peri-implant conditions.
4. Possible bone reconstruction prior to implant placement, when simultaneous implant placement and reconstruction cannot be performed (healing occurs with a fixed provisional restoration). This step is not always needed and depends on the anatomic conditions after implant removal.
5. Implant insertion after 8-12 weeks of healing; when a GBR technique is needed to correct residual peri-implant defects in this phase, the staged approach is truly beneficial. When performing a GBR to treat a peri-implant defect it is very advantageous to allow healing to occur under the protection of a fixed provisional restoration\textsuperscript{15,16}. 
6. Early or late Explantation/extraction. This is performed when the newly inserted implants may be loaded. At this time the provisional is usually supported solely by the new healthy implants.

7. When needed, a second phase of implant insertion may be performed at this time.

8. Soft tissue conditioning, implant-level impression and delivery of the final restoration

Table 1 shows treatment steps according to the staged approach. The definition of interval from extraction and loading times are the ones proposed in the ITI consensus 2018 (Galluci et al 2018)

Case description:

The patient was unsatisfied with the esthetic appearance of the fixed full-arch restoration, which was supported by a combination of teeth and implants. She was also experiencing recurrent acute infections at several abutments with pain and localized swelling. The patient’s oral hygiene was considered acceptable, however due to the presence of generalized soft tissue recession with exposed implant threads, there was a localized heavy plaque build-up. (preliminary diagnosis; figures 1 and 2).

All the natural dentition was deemed hopeless due to recurrent decay associated with open margins, endodontic lesions and unfavorable crown-root ratio. Upon prosthesis removal it was also obvious that the position of many implant fixtures was not compatible with an esthetically pleasing result, because of an excessive buccal positioning (figures 3 and 4). Implants and teeth needed to be removed with the exception of the implant in position 2.5, which had an external hex connection. In the first stage of treatment implants 1.5, 1.3, 2.3 and tooth 2.1 were removed. (Provisional fabrication, prosthesis removal and first extractions/explantations and definitivel treatment plan: phases 1 and 2). As a consequence of this treatment soft tissue appearance and health considerably improved (figure 5).

A fixed, implant-supported provisional was in use in this phase. After 8 weeks of healing implants were placed in positions 1.4, 1.2, 2.1, 2.3 (ITI Type 2-3B). Contour augmentation was necessary around 1.2 and 2.3 (Implant placement and GBR: phase 4; Figure 6).

Following a second healing period of 8 weeks extractions were completed and further soft tissue healing was accomplished (completion of extraction/explantation (phase 5; Figure 7). An implant-level impression was made of the healed implants and a final screw retained porcelain-fused to metal FDP was delivered to the patient (phase 7; Figure 8).

In the mandible, a conventional approach was selected: the implants were removed at the same time and the patient was given a conventional immediate denture. After a standard healing period, 4 new implants were placed in the mandible and splinted with a bar to support a mandibular overdenture.
The patient was satisfied with the appearance and function of her implant-supported restoration. Furthermore, she could perform optimal oral hygiene around the new restoration.

Discussion

Full-arch fixed restorations supported by implants or by a combination of implants and teeth may fail. If this happens because of complications of the natural or artificial abutments that need to be removed the clinician is faced with a challenging scenario.

The decision-making process whether to keep or to remove a failing tooth or implant is not a topic of this paper, but some considerations need to be made in this regard.

The leading biologic complication of full-arch implant-supported restorations according to a recent systematic review is the presence of peri-implantitis with crestal bone loss exceeding 2 mm (20.1% and 40.3% respectively at 5- and 10 years)\(^1\)These numbers suggest that peri-implantitis may affect a large percentage of implants supporting full-arch restorations. If the restoration is stable, functioning and esthetically acceptable the abutment related therapy must be conservative. Every attempt to maintain the original abutments should be performed when the original restoration may be kept in place.

It should be noticed however that, when a new prosthesis has to be delivered, it might not be advisable to keep questionable abutments (natural or artificial) that may jeopardize the result of the new restoration.

Encouraging data exists on the long-term outcome of restorations supported by teeth with reduced periodontal support or endodontic treatment\(^{17,18}\) therefore the clinician has some evidence to guide the therapeutic decisions.

Unfortunately, when it comes to implants, few data are available on long term prognosis of implants affected by progressive bone loss due to peri-implantitis despite treatment\(^4\). When a new prosthesis is necessary a more aggressive approach towards failing implants may be justified. In the clinical scenario of a planned new prosthesis a favorable prognosis of each abutment is necessary.

The staged approach has already been proposed as a means of transitioning from a terminal dentition to a full-arch implant-supported fixed prosthesis\(^{5,6,7}\). The main characteristic of this treatment option is to retain strategic prosthetic abutments in the short-term, whose prognosis is nonetheless hopeless and that are therefore destined for extraction/explantation, in order to use them to support a fixed provisional prosthesis. Despite higher costs due to one or more provisional restorations and inevitably lengthened overall treatment time, the staged approach provides a significant advantage, namely that it avoids a phase with a removable prosthesis. This not only responds to the desire of many patients to avoid transitional dentures, it also provides a significant advantage when bone augmentation is necessary because it eliminates
the inevitable micro-movements that are transmitted to the oral tissues by a removable prosthetic device.

Furthermore, the provisional phase of treatment allows the clinician to assess patient critical factors such as patient compliance and oral hygiene. Often patients that are restored with a full-arch implant supported restoration have a history of periodontal disease and may require oral hygiene instructions and to be re-educated regarding their oral hygiene.

The periodontal related risk factors are also involved in the occurrence or progression of peri-implant disease. In this respect, longer treatment times permits a more effective patient motivation towards control of such risk factors.

Conclusions

The proposed staged approach has some drawbacks including: increased treatment time, possible extra-cost due to the need to treat abutments that will be finally removed or to provide multiple provisional restorations, increased chair-time, and possible increase in the number of surgical steps.

The advantages are related to the fixed provisional restoration used throughout the tretament, with improved patient comfort, more effective soft and hard tissue healing at sites treated for implant insertion or with a staged or simultaneous bone augmentation that is often needed in these cases to overcome the bone atrophy related to tooth loss or implant removal.

References

Table 1: Possible treatment options in cases of transition from a failing extensive implant supported restoration. The definition of interval from extraction and loading times are the ones proposed in the ITI consensus 2018 (Gallucci et al 2018)

<table>
<thead>
<tr>
<th>Treatment Type</th>
<th>Timing of Implant Placement in relation to implant/tooth Removal</th>
<th>Timing of Implant Loading</th>
<th>Provisional Restoration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conventional</td>
<td>6-8 weeks after extraction</td>
<td>Conventional (3-6 months) or early (1 week-2 months) (Type 2-3B, 2-3C, 4B, 4C)</td>
<td>Removable</td>
</tr>
<tr>
<td>Immediate placement</td>
<td>At the time of extraction</td>
<td>Conventional (3-6 months) or early (1 week-2 months) (Type 1B, 1C)</td>
<td>Removable during osteointegration time</td>
</tr>
<tr>
<td>Immediate loading</td>
<td>6-8 weeks after extraction</td>
<td>Within 1 week (Type 2-3A)</td>
<td>Removable and then Fixed immediately after implant placement</td>
</tr>
<tr>
<td>Immediate placement with immediate loading</td>
<td>At the time of extraction</td>
<td>Within 1 week (Type 1A)</td>
<td>Not described in the literature</td>
</tr>
<tr>
<td>Staged approach</td>
<td>6-8 weeks after extraction</td>
<td>Early (1 week-2 months)</td>
<td>Fixed throughout the treatment</td>
</tr>
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</table>
Table 2: Treatment steps according to the staged approach. The definition of interval from extraction and loading times are the ones proposed in the ITI consensus 2018 (Galluci et al 2018)

<table>
<thead>
<tr>
<th>Treatment phase</th>
<th>Objectives/notes</th>
<th>Timing of treatment (weeks)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Periodontal causal therapy</td>
<td>Significant improvement of marginal soft tissue</td>
<td>2-4</td>
</tr>
<tr>
<td>2 Original FDP Removal and extraction/explantation</td>
<td>Delivery of provisional FDP and initial socket healing</td>
<td></td>
</tr>
<tr>
<td>3 Re-evaluation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Staged bone augmentation (if needed)</td>
<td>When augmentation cannot be performed at the time of implant placement</td>
<td>8 weeks after phase 2</td>
</tr>
<tr>
<td>5 Implant insertion and GBR</td>
<td>(ITI Type 2-3B)</td>
<td>8 weeks after phase 2 or 16 weeks after phase 3</td>
</tr>
<tr>
<td>6 Final extraction/explantation</td>
<td>When early loading of the new implants with the provisional FDP may be performed</td>
<td>8 weeks after phase 4</td>
</tr>
<tr>
<td>7 Second stage implants (if needed)</td>
<td>performed after the final extraction explanation phase when more implants are planned (ITI Type 1B or 2-3B)</td>
<td>At the time of phase 5 or 8 weeks later</td>
</tr>
<tr>
<td>8 Final soft tissue conditioning and final prosthetic phases</td>
<td>Delivery of the final restoration</td>
<td>8 weeks after phase 4 or 6</td>
</tr>
</tbody>
</table>
Figures:

Figure 1. Clinical case at presentation. Patient was unhappy with the esthetics of the implant-supported prosthesis. Note the exposed threads with accumulated plaque and debris despite adequate oral hygiene. Also note the inflamed and edematous peri-implant and periodontal tissues.

Figure 2. The panoramic X-ray shows, in the maxillary arch, incomplete seating of the prosthesis and that many of the tooth-supported restorations have open margins. An unstable removable prosthesis supported by failing implants and a natural abutment was present.
Figure 3. Once the restoration was removed, it was clear that the implant position is not appropriate and that many implants show extensive bone loss and soft tissue recession. The remaining abutment teeth show extensive caries and periodontal disease.

Figure 4. From the occlusal view it is clear that the implants are positioned in a buccal position and probably outside bony contour. It is also clear that many of the implant and natural abutments may not be used as a support for a new restoration.

Figure 5. Sequential explantation of implants 15, 13, 24 and tooth 21. Note the clinical improvement of the soft tissue appearance. All the present abutments will be eventually removed with the exception of one external hex implant in the position of the second left premolar.
Figure 6. Implant placement. GBR and contour augmentation was necessary around 1.2 and 2.3. The surgical view clearly indicates that bone resorption around implants is related to the buccal inclination and position of the failing implants.

Figure 7. Occlusal view after placement of implants 1.4, 1.2, 2.1, 2.3. The different bucco-palatal position of the newly placed implants when compared to the failing is clear. In this period the patient is using a provisional FDP supported by 3 implants and 2 failing natural abutments. Healing of the newly placed implants with bone augmentation procedures occurred without compression or micromovements caused by a removable prosthesis. In the mandible, all the implants were removed simultaneously and the patient was given a conventional immediate denture. After a standard healing period, 4 new implants were placed in the mandible to support a mandibular overdenture.
Figure 8. Final restoration: occlusal view of the final 5 implant abutments used to support a one piece metal ceramic FDP. Intraoral x-rays and frontal view of the final restoration.

Figure 9. Panoramic radiograph showing stable marginal bone levels after 1 year.