Effect of Tongue Thrust on Implants Integration

Luca Dal Carlo, Zeno Dal Carlo, Marco E. Pasqualini, Enrico Moglioni, Mike Shulman

ABSTRACT

The human tongue is a muscular organ with a variety of life-important functions. Mastication and swallowing, taste, and speech are vital functions. From the analysis of the lingual function, clinical considerations during the oral-pharyngeal phase of swallowing, the tongue thrusts anteriorly and laterally, creating enormous pressure. If it applies to freshly inserted dental implants, it could be leading to early implant failure.

Different authors have calculated this pressure between 20 and 200 kPa, depending on tongue volume, producing resultant torsion forces on implant abutment. The work aims to understand the importance of the destabilizing action of the tongue in the post-operative period.

When the use of implants resting in quiescence for a long time under the gums is not possible, because of anatomical reasons (for example: thin ridge), or: immediate loading is planned, the action of the tongue must be considered.

We are proposing some solutions to the problem to improve therapeutic safety: 1) Attach immediate provisional prostheses to existing adjacent teeth. 2) Immediately upon implants insertion, rigidly connect implants. 3) When an immediate loading protocol is implemented, the operator should follow the guideline, taking care to apply correctly balanced axial forces, without any lateral stress.

Our professional experience, based on over 10,000 clinical cases performed during 35 years, confirms that, with implants emerging in the oral cavity, handling in proper way the tongue thrust during the healing period makes the difference.

All what has been here implemented about this subject, represents the development of the legacy left by Prof. Ugo Pasqualini, an Italian dentist who, since the seventies, has been deepening the topic of the risks tied to the intra-oral stresses acting on the emerging part of the implants.

Keywords: Implant's failure due to lateral pressure, thin bony ridges, tongue pressure during swallowing, tongue thrust.

I. INTRODUCTION

When implant integration takes place, the behavior of the bone is controlled by the immobility of the endosseous part of the implant.

Submerged two-stage implants are protected from trauma when necessary to achieve integration.

One-piece implants can often be used when narrow ridges and submerged implants are too wide. There are specific advantages of the one-stage, monolithic (One-Piece) implants. Among them, greater resistance, simplicity of use and reduction of surgical times, and simplified management of the insertion path by bending the abutment to a perfect position at the time of the surgery [1].

One stage immediately loaded implants rigidly connected at the time of the surgery.

However, having these implants exposed and bearing functional load from the day on, the specific requirements have to be fulfilled; the implant is immobile from the moment it was inserted into the bone [2].

It was formulated in multiple publications and established no difference in bone integration between submerged and non-submerged implants. On the other hand, the quality of the bone around integrated implants submerged or non-submerged is different. The bone quality will differ whether the implant was immediately subjected to functional load or delayed [3].

Whether immediate or progressive, the functional load will change the bone structure, while implants without load will not stimulate bone changes around them.

While contemplating an immediate load, one of the most destructive and challenging factors that need to be considered is the tongue thrusting effect.
Pre-surgical, surgical, and healing stages have various problems and solutions that can compromise or increase success.

The most common components are surgical and post-operative pharmacological implementation, maintenance and hygiene, and prosthodontics from the treatment planning to the final restoration and predictable maintenance.

We want to discuss the physiology, most commonly underestimated and addressed inadequately.

From the literature analysis, immobility is an essential condition for implant integration, whether the fixture is submerged or not submerged. The Authors analyze the damaging function of the tongue from the evaluation of the clinical cases. Long-standing posterior edentulism can become habitual tongue thrusting action. Tongue thrusting can be anterior or posterior, unilateral or bilateral. Tongue thrusting through edentulous spaces can be diagnosed and observed during swallowing by retracting the cheek and asking the patient to swallow [4].

The functional activity of the tongue creates forces in the horizontal direction that can cause put the implants, especially at the healing stage, at risk. Long-standing posterior edentulism is common, and treating doctors should explain to the patient, risks, and possible learning curve during rehabilitation.

The treatment plan will vary based on preexisting conditions, the longevity of edentulism, length of the edentulous ridges, included defect with or without teeth on proximal sites, edentulous ridge width, and height.

A fundamental condition to achieve implant integration is that the implant remains immobile after its insertion into the bone tissue.

A two-stage implant placement protocol is advised when limited implant stability, ridge deficiency, or the bone graft necessity. It is easily achievable with submerged implants, if the bony ridge is enough wide to receive them.

When the operator chooses to utilize one-stage implant placement protocol, recommendation on how to protect inserted implants immediately [6]:

- Attach immediate provisional prostheses to existing adjacent teeth.
- Immediately upon implants insertion, rigidly connect implants.
- When an immediate loading protocol is implemented, the operator should follow the guideline, taking care to apply correctly balanced axial forces, without any lateral stress.

The clinical data presented in this article were accumulated for over 35 years. The over 10,000 clinical completed cases, variety of submerged and non-submerged dental implants from the treatment planning to the final prosthesis insertion analyzed in this article.
oblongata and coordinates the numerous actions that take place: constriction of the pharynx, cessation of breathing, raising of the soft palate to block the nasopharynx, raising of the larynx and closing the epiglottis, peristalsis of the esophagus.

The numerous essential functions of the tongue, including taste, speech, and swallowing. Of the three main functions, the activity for survival has a moment in the oropharyngeal phase, which is particularly critical for the implants during the integration phase.

The tongue is a muscle whose peristaltic activity determines the progression of the food bolus and the liquids present in the oral cavity towards the esophagus.

The oral-pharyngeal phase of swallowing occurs when the elevator musculature of the mandible contracts, bringing the two arches into a forced occlusion, while the suprahyoid muscles contract, elevating the tongue which, pressing against the dental arches, pushes the bolus into the retropharynx, without the tension of the soft palate, the apnea and the positioning of the epiglottis to protect the glottis allowing deviations from its course towards the esophagus.

The phase described above occurs in a state of apnea and involves a significant pressure on the present teeth [4] (Fig. 2).

IV. EFFECT OF TONGUE’S EXPANSION

During swallowing, the tongue presses against the crowns of the natural or prosthetic teeth, producing a rotational momentum of force (Fig. 3).

The bone will absorb and dissipate the forces transferred from the natural or prosthetic roots. If the stress is more significant, than counterbalancing mechanism, the tooth will move. The bone on the opposite side where the stress is applied will be resorbed, allowing the tooth to move, dissipating the forces. A similar situation with dental implants will cause newly inserted implants to possibly be lost.

The action of elevator muscles favors the success of implants loaded immediately if the bite registration [6] has been so accurate that only an axial force is discharged on the implant-supported prosthesis, which stabilizes it during swallowing, protecting it from any lateral forces (Fig. 4).

A similar approach must be used for both temporary prosthesis and the definitive one to avoid premature, deflecting contact originating from acentric mandibular movements [6].

If dental prosthetic elements are missing, the tongue crosses the edentulous ridge when swallowing.

This expansion continues until the tongue finds resistance from the prosthesis teeth, which act as a wall. If the pressure from the tongue is higher, than newly placed implants can tolerate, it may reverse implant integration. Potentially it can lead to the failure of non-submerged implants.

The rehabilitation of long-standing edentulous ridges can be more problematic as the operator has to deal with previously accommodated tongue positions. The retraining of the tongue most common issue doctors have to deal with; some recommendations:

— proper teeth width and positioning following Spee curve and providing enough space for the tongue by finding a proper buccal-lingual position for the teeth.
— The adaptation of the tongue can be predictably made with gradual adjustment of the temporary prosthesis.
— Immediate replacement of the existing failing prosthesis will require less tongue training, the contour, width, and buccal-lingual position should be duplicated or modified if needed. Therefore, less time for tongue accommodation will be required.
— Doctors should analyze possible tongue thrusting actions before every patient’s therapy, and it is essential for a proper treatment plan.

V. LEVELS OF RISK

Following factors can increase the risk for implants survival.

1. Long-standing edentulous condition.
2. Tongue size.
3. Limited bone quality and quantity; height and width.
4. Abutment height and positioning.

The tongue creates lateral forces during swallowing (Fig. 3). This pressure has been calculated by [8]-[14].
The average pressure is between 20 and 200 kPa.
If the abutment height is 10 mm, the tongue can produce 10 to 100 kPa.
If the abutment height is 5 mm, 5 to 50 kPa can be applied. If the abutment has 1 mm height 1-10 kPa, there is no pressure when the abutment is 0 mm height (Table I and Fig. 5).

<table>
<thead>
<tr>
<th>Tongue Pressure</th>
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<th>Surface</th>
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<tbody>
<tr>
<td>20 kPa</td>
<td>10 x 5 mm</td>
<td>0,5 cm²</td>
<td>10 kPa</td>
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<tr>
<td>200 kPa</td>
<td>10 x 5 mm</td>
<td>0,5 cm²</td>
<td>100 kPa</td>
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<td>20 kPa</td>
<td>5 x 5 mm</td>
<td>0,25 cm²</td>
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<td>200 kPa</td>
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<tr>
<td>200 kPa</td>
<td>1 x 5 mm</td>
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Fig. 5. Min and max average tongue pressure in relation to abutment height.

Pressure on the abutment causes force momentum: the higher the abutment, the larger the momentum of force. The force applied on the abutment top is multiplied by the distance between the abutment top and crest of the bone will quantify the amount of stress produced. The implant has to have adequate bone-implant contact to resist stress (Fig. 3).

The supporting bone absorbs and dissipates the forces applied to the implant. As a result, the longer the implant is, and the denser the bone is, the more implant stability will be maintained.

Bicorticalism, when the implant has engaged into the opposite cortical bone [15] (for example: bicorticalism on the mylohyoid line), the more stable the implant is and the lesser chances that the tongue can destabilize implant.

VI. ROTATIONAL FORCES OF THE TONGUE

A rotary action also accompanies the expansive action of the tongue when swallowing. The tongue presses from the back to the front, creating stress which produces unscrewing action.

The screw implants are placed in the lower left and upper right quadrants [4]. The unscrewing action is seen with healing caps of submerged implants [6].

VII. SUBMERGED IMPLANTS

The anatomical conditions dictate using a submerged implant with a staged approach. Acquired factors, bone quality and quantity, and resorption pattern will not recommend an immediate function due to the higher risk; a submerged implant will be an appropriate choice (Fig. 6).

Advantages and disadvantages Monolithic (one-stage implants) and submerged (two-stage placement protocol) implants.

Ridge deficiency, necessary to graft the ridge to place submerged implants. Utilizing small diameters implants can eliminate more involved ridge augmentations and reduce rehabilitation time [3], [16]. This type of implant is advantageous when limited attached gingiva is present [17].

Evaluate the convenience of one-stage implants when planning immediate function [17], [18].

VIII. SOLUTIONS FOR THE TONGUE THRUSTING SITUATIONS

One can utilize residual or remaining teeth to stabilize the immediate prosthesis, add support, and withhold damaging stress from tongue thrusting. When the bony ridge is too thin to receive submerged implants, provisional prosthesis anchored to adjacent teeth can stand above the emerging part of the one-piece implants, letting them rest in total quiescence (Fig. 7).

One can rigidly connect immediately inserted implants with a welded titanium bar (Fig. 8, 9).
Fig. 8. Two one-piece implants (Linkow blade and Garbaccio screw) were inserted in a thin bony ridge. A titanium bar was intraorally welded, overlying the ridge center, rigidly connecting two implants and protecting them from tongue thrusting.

Fig. 9. Tongue thrusting was detected in the previous case, demonstrated in Fig. 8.

IX. CONSEQUENCES ON THE TONGUE THRUSTING

When the patients had long-standing edentulous spaces and immediate implant placement and function was implemented, bulky prostheses with irregular surfaces can cause tongue ulcerations. Due to swelling and unusual tongue restrictions during the healing stage, the patient can occasionally bite the tongue, creating multiple wounds in the mouth.

Simple and effective remedies for lingual ulcers;
1. proper prosthesis emergence profile,
2. convex polished surfaces in a proper inter-arches alignment,
3. adequate medications.

X. CONCLUSION

The success of an implant therapy depends on:
1. Proper treatment planning.
2. Detecting and handling tongue thrusting.
3. Using appropriate one-stage immediate function protocol or staged procedure. Proper prosthetic design following main principles of occlusion and harmony [19, 20].
4. Proper, staged rehabilitation will eliminate all functional and cosmetic disadvantaged statuses and optimize functioning and improve quality of life.

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CONFLICT OF INTEREST

Authors declare that they do not have any conflict of interest.

REFERENCES

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Author of 100 scientific articles about the topic of implant dentistry, whose contents have been incorporated in his text book “Elementi di Selezione degli Impianti Endoossali” 2020, Edizioni Accademiche Italiane. Several textbooks from Specialists of Implant Dentistry host chapters from him.

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Author and co-author of 85 articles that have been published in national and international scientific journals, he has a personal photographic archive about dentistry composed of more than 20,000 slides. He worked with his uncle, Prof. Ugo Pasqualini, for 20 years in both daily practice and research work, and shares his scientific principles, outlined in the book “Occlusal pathologies. Pathogenesis and therapy” (Italian).

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