



THE AURIGA PROTOCOL FOR THE UPPER JAW

Dentistry

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ABSTRACT

Doctor Luca Dal Carlo, Venice, Italy, introduced the Auriga protocol. Auriga protocol is suggested for rehabilitating partially edentulous, potentially fully edentulous, and fully edentulous patients with immediate interim and final fixed prostheses. After the patient's evaluation and treatment plan are completed, stage one: implants are placed bilaterally into the maxillary tuberosities. After implants are integrated, usually 4-6-month, the stage two, the remaining teeth on the maxillae are removed and immediately replaced with dental implants. All implants are rigidly connected (welded) with a chairside fabricated titanium bar. Prefabricated interim prosthesis adopted and attached to the formed rigid structure. Auriga protocol offers different methods to attach an interim and a final prosthesis. During a period of over 20 years (1998-2019) 223 implants have been inserted into 47 maxillary arches, providing 18 full-arch and 29 unilateral fix prostheses. Just 3 implants were lost: no one of the 47 rehabilitations was compromised.

KEYWORDS

Maxillary implant protocol, Bicortical one-piece implants, Intra-oral welding, Blade implants, Tuber-pterygoid implants

INTRODUCTION

Many dental schools worldwide have contributed to the evolution of oral implantology.

In the early 40s, subperiosteal implants became a valid modality with a robust design and procedure protocol, while the endosseous implant was at an earlier development stage.[1]. The clinical evidence and multiple histological studies proved endosseous implants' functionality and clinical success [2-6], which dramatically improved when titanium became the material of choice.[7-9].

Historically, monolithic or one-piece implants were invented and used first, and as technology-enhanced, the two-piece implants were developed, and two-stage procedures became available. The implants can be submerged, exposed, and restored later when integrated.[10]. Newer modalities, two pieces of endosseous implants, added more vast possibilities. The histological analysis demonstrated the successful integration of titanium implants.[11-13]. Our experience with titanium implants, different shapes, and retained fixed prostheses demonstrated long-lasting, predictable results.

Many of our clinical cases were well documented, presented, and published in the peer-reviewed literature.[14,15]. It has been demonstrated and accepted by colleagues that rigidly connected dental implants can successfully withhold much stress after insertion.[16-19]. After implants are inserted, the titanium bar is welded to implants on the implant or abutment level immediately, and a rigid structure can be immediately loaded.[20-21]. In many clinical situations in the entire upper jaw, older patients with moderate to severe jaw resorption need complete rehabilitation with dental implants and interim prosthesis loaded immediately; described scenarios with different implants rigidly connected can be loaded immediately. Patients can benefit from the fastest and most favorable results. "AURIGA" protocol is recommended for rehabilitation patients with deteriorating fixed or removable prostheses on the upper jaw.

In both situations, when patients are presented with fixed or removable prostheses and need to replace them, they will immediately transition into fixed upper prostheses.

The Auriga Protocol

Auriga protocol is suggested for rehabilitating partially edentulous, potentially fully edentulous, and fully edentulous patients with immediate interim and final fixed prostheses.

Doctor Luca Dal Carlo, Venice, Italy, introduced the Auriga protocol. Clinical cases performed and presented by Dr. Luca Dal Carlo. Mr. Ivan Steffan, Venice district, Italy, completed laboratory work.

Step-by-step procedures are described in this article with the author's recommendations. Multiple cases and publications demonstrate a solid foundation to prove successful outcomes when doctors follow the protocol.

One of the most significant advantages is that the Auriga protocol provides fixed prostheses from the day in which the previous prosthesis is disassembled.

Also, Auriga Protocol presents conservative rehabilitation of the full or partially edentulous upper jaw with fixed prosthesis all the time.

Another advantage Auriga protocol is that it can eliminate complicated surgical procedures like sinus augmentation.

After the patient's evaluation and treatment plan are completed, stage one: implants are placed bilaterally into the maxillary tuberosities. After implants are integrated, usually 4-6-month, the stage two, the remaining teeth on the maxillae are removed and immediately replaced with dental implants. All implants are rigidly connected (welded) with a chairside fabricated titanium bar.

Prefabricated interim prosthesis adopted and attached to the formed rigid structure. Auriga protocol offers different methods to attach an interim and a final prosthesis. Traditionally prostheses were cemented over formed rigid frames.

The newer Auriga modification offered the prostheses to be screw retained. Auriga's modification, called "Spinweb" screw-retained prosthesis simplifies and increases predictability for the fixed, screw-retained prostheses.[22]. A new category of fixed-detachable prostheses offers many benefits, and the most practical is the prosthesis's retrievability. The prosthesis can be easily removed and placed back by the doctor.

Need for retrievability:

- Loosening abutment screws.
- Hygiene.
- Prosthesis repair.
- Soft/hard tissue management.

- Implant management.

Techniques

Stage 1

Treatments start with placing two stage-implants bilaterally into maxillary tuberosity/pterygoid processes. That concludes surgical treatment stage one.

Stage 2

Stage two procedures are performed after four to six months when previously placed implants are integrated.

All non-restorable teeth are removed and replaced with bicortical fixated dental implants.[5].

Based on the bone availability and the operator's expertise, many implant modalities can be used: blade implants, mono-block (one-piece), or two-piece implants. One-stage implant placements according to protocol, reaching and engaging into the opposite cortical bone. Follow an atraumatic extraction protocol to remove remaining non-restorable teeth with minimal flaps.

Immediate post-extraction implant placement into sockets following immediate implant placement protocol. Autogenous bone harvested during osteotomies is utilized to graft post-extraction sockets. Additionally, implants can be placed in available bone close to the maxillary sinuses without the need to engage the maxillary sinuses.

Straight or angulated abutments matching the proper prosthetic path of insertion are placed and torqued down into two-piece implants.

All implants are connected at the implant or abutment level with a passively adopted titanium bar, utilizing Mondani's intraoral welder [23-25].

A provisional prosthesis is relined, adjusted, and can be cemented over a rigid frame; bar connected with implants (abutments).

The new modification in Auriga Protocol proposes predictable screw fixation. It eliminates the necessity for cementation over the abutments and bar.

Patients selection

The Auriga protocol recommended full rehabilitation of the Maxilla with grade 2-3 atrophy (figure 1). In patients with expanded maxillary sinus, the middle third of the upper jaw is atrophic; nevertheless, the maxillary ridge (pre-maxillae) before the expanded maxillary sinus and maxillary tuberosities have some residual bone.

Auriga protocol is a conservative treatment for class 2 and 3 maxillary bone atrophy and can be provided by general dentists and specialists.



Figure 1 Different levels of residual trophism of the maxillary alveolar ridge.[22].

Requirements are:

presence of adequate bone on anterior Maxillae up to the mesial wall of the maxillary sinus and posterior Maxillae behind a distobuccal wall of the maxillary sinus, maxillary tuberosity, and/or pterygoid process. A minimum of 3mm bone width is required bucco-lingually and at least 10mm height from the crest of the ridge. In clinical situations, when patients present with failing teeth in the anterior maxillae, a minimum of 5mm apical bone required to establish primary implant stability. In Maxillary tuberosity, implants are placed behind the maxillary sinus,

where width and height are sufficient. When maxillary tuberosity has insufficient bone, an implant can be advanced into the pterygoid process.

All treatment planning utilizing the preoperative model, X-Ray, CBCT. Surgical Guides are suggested to improve implant positioning. Radiographic control is recommended during surgery and to evaluate the final position.

Figure 2 describes clinical procedures where the pre-maxilla is wide enough to receive screw implants.

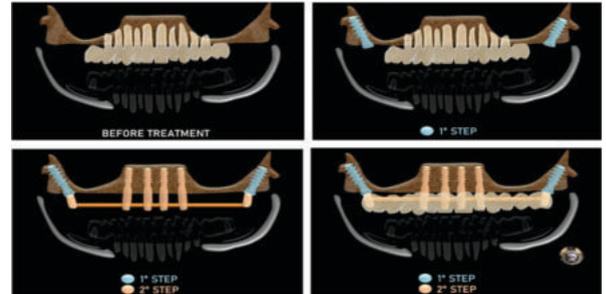


Figure 2

Upper left - Before treatment. Upper right - Step 1. Two submerged screw implants were inserted into tuberosities, engaging the pterygoid process. Lower left - Step 2. After teeth extraction, four screw implants were inserted in the anterior maxilla and immediately connected to the previously inserted screws in the posterior maxillae with a welded titanium bar. Lower right: At the end of the surgical session, a provisional fixed prosthesis has been relined and cemented to the rigid structure, six implants, and the connecting bar.

Figure 3 describes clinical procedures where the pre-maxilla is thin. At the end of the surgical session, a provisional prosthesis was screwed in (Auriga 19 prosthetic upgrade).[22,26].

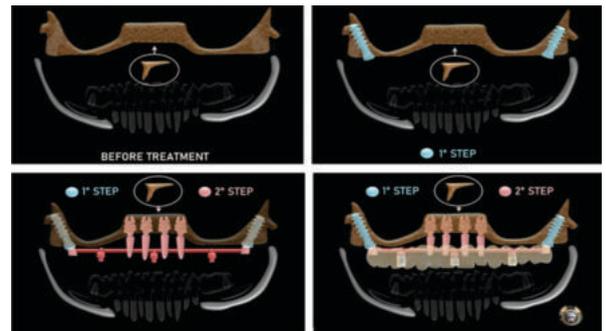


Figure 3

Upper left - Patient with a thin pre-maxilla before treatment. Upper right - Step 1. Two submerged screw implants are inserted in tuberosities, engaging into the pterygoid process. Lower left - Step 2. Four blade implants (wedge form) inserted in the anterior maxilla and immediately connected to the previously inserted posterior screws (implants). Prefabricated chairside titanium bar with connectors intraorally welded to the implants with an electro-welder. Lower right - At the end of the surgical session, the provisional fixed prosthesis was screwed onto the connectors on the connecting bar.

In both cases, the final prosthesis can be cement-retained or screw-retained at the operator's preference.

DISCUSSION

The Auriga protocol was utilized since 1998 for unilateral cases and, in 2002, extended for full-arch cases [27-29].

Stages of Auriga protocol

Doctors will begin with placing implants into the maxillary tuberosity region. Integrated implants were uncovered and connected with just-placed implants in the anterior area. Intraoral welding is utilized to connect all implants rigidly; this assures primary/secondary stability and ultimately increases the success rate. With the Auriga rehabilitation protocol, the interim prosthesis is fixed; this increases comfort and easy-up rehabilitation time for the patient. The fixed interim prosthesis will substantially reduce any psychological and

physiologic unfavorable patients experience. Having stable occlusion will simplify CR verification and establish proper vertical dimensions. Stable proper occlusion will eliminate potential muscular and TMJ imbalance.

Incorporating new addition screw-retained fixation to the Auriga protocol will minimize the complexity of temporary and permanent prosthesis fixation and advances in retrievability [22,26].

Posterior Maxillae

The success of dental implants placed in maxillary tuberosity has been proven for years. Bone quality falls in the category of soft to very soft, anatomically is a trabecular, poorly mineralized bone. It is logical because this bone had never sustained load. Therefore, implants placed in this area are recommended following a two-stage protocol and progressive loading in the second stage. In cases with severe resorbed maxillary tuberosities, the implant can be extended and engaged in the pterygoid process.

Successfully integrated and functioning and followed up for over twenty years [15], dental implants were documented and publicized in multiple peer-reviewed publications.

Historical perspectives

Dr. Pierluigi Mondani invented intraoral welding in 1968. The prototype of the intra-oral welder is glorified in the Odontology and Implant Dentistry section of the Museum of Medicine in Venice, Italy. An extensive exhibition of historical implant items presented Odontology and Implant Dentistry section of the Museum of Medicine in Venice, Italy.[30-31].

Since the late sixties, the opportunity of welding titanium intra-orally inspired multiple different applications. One of the main indications was the immediate loading by connecting different implant modalities like blade implants, one-piece implants, and two-piece root-form implants.

All implant modalities can be intraorally rigidly connected with a welded titanium bar.

Submerged implants Branemark-style are considered for delayed load.[34]. In the second stage, when implants are integrated, they can be rigidly connected to the other implants utilizing intraoral welding to form rigid fixation. Alternatively, submerged implants can be welded immediately after placement to enhance the quality of the gingival seal, which is a proven practice that should be considered.[35-37].

Former studies regarding the integration of non-submerged implants, exposed to the oral cavity, versus submerged implants, non-exposed to the oral cavity, were published during the early 90s [38]. The favorable results from the earlier researchers were confirmed.

U. Pasqualini, from 1956 to 1962, performed multiple implant placements on 28 dogs, demonstrating the same rates of bony apposition and adhesion to the submerged and non-submerged implants [14,39].

Dr. Leonard Linkow utilized different endosseous dental implant modalities, from 1963 root forms and, starting in 1967, blade implants. The large number of dental implants Dr. Linkow placed and loaded immediately. One of the critical elements, implants were rigidly connected with an interim prosthesis.

Leonard I. Linkow, during the Chicago Midwinter Meeting in 1973, performed five live surgeries on patients. Partially and completely edentulous patients in one appointment were rehabilitated with fixed interim prostheses supported with blade implants [40].

Procedures with one and two stages of implant placement protocol staged when implants at the second stage can be connected immediately with newly placed implants and rigidly connected utilizing Mondani intraoral welder and adopted titanium bar [26].

Equivalent interventions are follow-up results published in the 1990 textbook by Linkow L.I. [41].

In 2005 Rossi, Pasqualini and Manenti published the protocol for immediate full arch rehabilitation [42,43].

There is a concise list of published essential principles; one-piece implants and bicorticalism [44], proper implant position [45,46], prosthetic bar positioning[47], and occlusal balance[48,49].

Cases presentation

Clinical case: 1

Patient, 54 years old Caucasian female, presented with a fixed upper full-arch bridge retained by the deteriorating teeth.

Teeth are affected by periodontal disease. In the right maxillary sinus, thickening of the mucosal membrane due to odontogenic infection. Anterior maxillae; failing implant (area 1.2).

Area 2.1-2.3: exhibit extremely thin ridge. On posterior maxillae, CBCT reveals no tuberosities; they are completely reabsorbed.

The patient's primary concern is painful upper teeth and unappealing esthetics—inflammations and bleeding around existing dentition.

Auriga protocol was applied, 2 submerged bicortical implants on each side in the Maxillae. Implants were placed in the maxillary tuberosities, extended, and engaged in pterygoid processes bilaterally (Stage 1).

Four months later, the remaining deteriorating teeth were atraumatically removed, and two bicortical screws and one bicortical blade implant were inserted in the anterior maxillae.

A titanium bar was welded, connecting all the implants. A fully functional temporary full-arch prosthesis was adapted and inserted immediately (Stage 2). A final prosthesis was fabricated later.

Figure 4. Illustration for the procedure above.

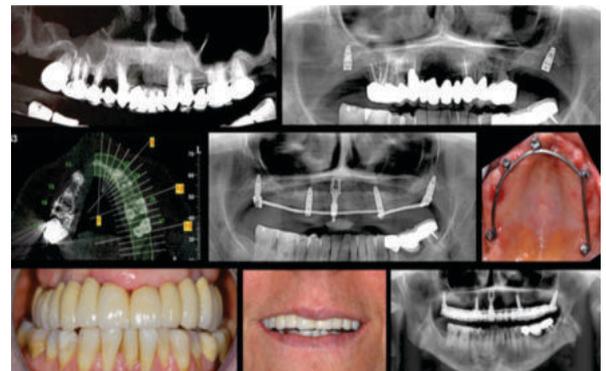


Figure 4

Upper Left. Pre-operative OPG. Center-left. CBCT displays a very thin ridge in the anterior maxillae. Upper right. Stage1: two submerged screw implants inserted in the pterygoid processes.

Center-Right. Three implants were added to the anterior maxillae. A titanium bar was welded intraorally, connecting all implants. Inferior. Final prosthesis and OPG.

Clinical Case: 2

The patient, 65 years old Caucasian woman, who was generally in good health, complained of an ill-fitting upper denture. Examination revealed moderate to severe maxillary bone resorption.

Auriga stage three maxillary atrophy.

Pre-maxillae, alveolar bone width averages 3 mm, height over 10mm. These determinations imply that patient is a typical candidate for an Auriga protocol full fixed upper jaw rehabilitation.

Following Auriga protocol, procedures were performed in the following order; two external-hexagon implants (Or-Vit Viteria Ortopedica SRL Bologna Italy) were placed in the maxillary tuberosity according to the stages procedure protocol.

In the second stage of the Auriga protocol, 4 blade implants (A-Z Implant SRL, Bologna, Italy) were placed in pre-maxilla.

A titanium bar was adopted and welded to the implants connecting them. The interim prosthesis was cemented and adjusted.(Figure 5).

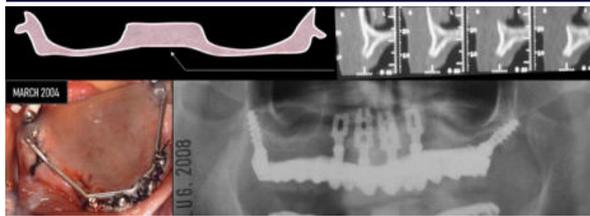


Figure 5 Upper. Auriga stage three maxillary atrophy. Inferior. Auriga Protocol performed, 4 years postop X-Ray.

Clinical case: 3

Patient, 82 years old Caucasian woman who is generally healthy and complains of an ill-fitting full upper denture. She has had this prosthesis for over thirty years. Lower jaw presents stable implant-supported prosthesis.

Intraorally: thick, mobile fibrous tissue over the anterior maxillary ridge.

CBCT review: sufficient bone in both maxillary tuberosities to place implants. Implant CDT (BioMicron sas) size 4,0 x 13-15 mm inserted into maxillary tuberosity.

Limited amount of bone under both maxillary sinuses (figure 6). The anterior and anterior-lateral maxillary process has an average of 3-4 mm in width and 8-12 mm in height available bone.

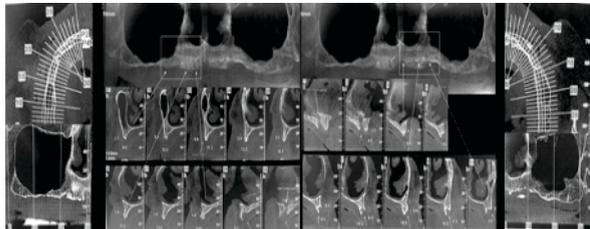


Figure 6. CBCT shows severe reabsorption of the pre-maxilla.

Following the Auriga protocol, first-stage tuberosity implants were placed (figure 7).



Figure 7. Stage 1. Posterior Implants.

The second stage is after tuberosity implants are integrated—implants placed at the anterior and anterior lateral maxillary process.(Figure 8).

This area presents particular limitations, narrow alveolar process. To follow the Auriga protocol and avoid bone augmentation procedures, 3 blade (narrow ridge) implants (BioMicron sas BioBlade type 1, Limbiate Italy) were placed along with 1 thin root form implant (Acerboni snc, Casargo Italy).

Tuberosity implants were uncovered, and abutments were torqued in. 3 blade implants and one narrow ridge root-form implant placed in the anterior maxillary alveolar process. Abutments adjusted to have a correct path of insertion.

Custom-made flat titanium bar (Acerboni snc, Casargo Italy) with attached screw retentive elements (A-Z Implant srl, Bologna Italy) was adapted and welded to the implants. The interim prosthesis was relined, and the secondary parts of the screw retentive elements were transferred to the prosthesis.

The new Auriga's prosthodontic element screw-retained prosthesis, "Spinweb," is used for temporary and permanent fixation (figure 8). The prosthesis seats on the bar and abutments while engaged screws retained the prosthesis in place. If there is a need to remove the prosthesis by unscrewing retentive screws prosthesis disengage and can be easily removed.



Figure 8

Upper. Stage 2. Anterior implants. Screw receiving connectors welded to the titanium bar. Bar welded to the implants. Provisional prosthesis screwed in. Lower. Final prosthesis and OPG.

Due to problems with the mastication apparatus previously, muscle activity diminished significantly.

Muscle activity undergoing functional recovery in the rehabilitation process after implants and prosthesis are delivered to the patient. Any potential premature contacts and unbalanced forces must be eliminated in occlusal rehabilitation.

EMG, T-Scan, and Mandibular Kinesiography are some tests suggested to evaluate, quantify and record TMJ and neuromuscular activity in functions such as chewing and biting. These devices help to monitor and quantify occlusal rehabilitation outcomes.

After the final, occlusal adjustments were made and verified. The patient is recommended to return in 30 days for a checkup and occlusal equilibrations if needed. During the following months, occlusal checks are suggested to prevent unbalanced forces, due to asymmetrical muscle recovery. Once stable occlusion is achieved, the patient is scheduled for routine recall appointments.

Clinical data

From 2004 till 2019, 18 full maxillary arches patients were rehabilitated utilizing 147 implants.[22].

1 implant was lost after 8 years of function. This implant was nonessential for prosthetic stability. No other problems have been reported until today.

From 1998 to 2019, 29 maxillary unilateral fixed prostheses were completed utilizing 76 dental implants. 2 implants were lost at earlier stages; they were nonessential for prosthetic rehabilitation—no problems have been reported until today.

Summary

Auriga protocol is recommended for patients with complete or partially edentulous Maxillary jaw. Doctors performing this procedure in two stages will maximize patient comfort and minimize procedure morbidity. They are controlling the cost by eliminating expansive procedures and ultimately elevating patient acceptance rate. There is some learning experience, and some additional training is suggested. All authors are available to provide support for the attending operators.

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