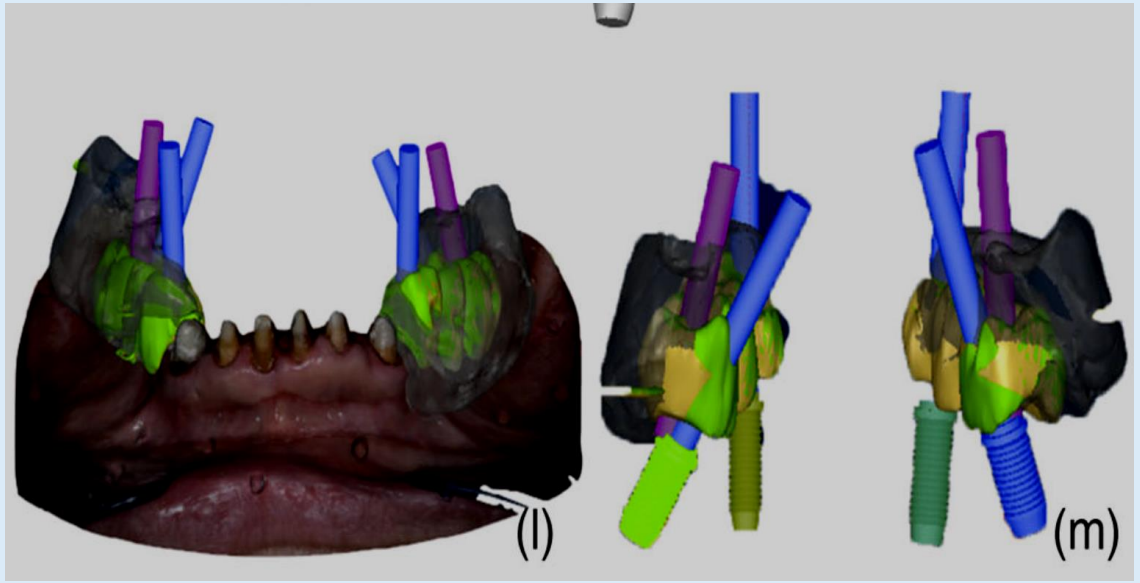
Neutral zone recording in computer-guided implant prosthesis:



Assist. Prof. Ghasak H .Jani

A new digital neuromuscular approach

Recently, the increasing demand for full-arch rehabilitations supported by dental implants imposes to ponder over the physiological integration of the prosthesis. In order to obtain patient satisfaction, the adequacy of both function and esthetics remains a key.

The achievement of functional integration is probably the most challenging goal to attain for the clinician. As widely reported by scientific literature, in fact, the prosthesis integration depends on static and dynamic factors, including soft and hard tissues that constitute the denture borders and forces among them .

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According to this, prosthetic volume should be placed in a nonconflict area defined as neutral zone, a specific space in which the opposite muscular forces are equal to 0.

Neutral zone (NZ) is a specific area in the oral cavity where muscular opposite forces are null. NZ represents the ideal zone for prosthesis placement.

This assumption is corroborated by the evidence that natural teeth tend to fill the NZ space between tongue, lip, and cheek according to muscles effects and occlusal contact

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- Teeth volume, angulation, and diameter, in fact, are not accidental, and the denture should be manufactured according to these physiological parameters. NZ area can be recorded using an impression technique named **piezography**, which is a registration of the space defined by muscles pressure between tongue, lip, and cheek during functional activity (e.g., speak and swallow)

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When an implant-supported rehabilitation is planned, proper placement of fixtures is a keystone for its long-term stability and predictability, considering that implant position cannot be modified after surgery.

The correct implant placement and an ideal prosthetic design affect also the stability of implant components, involving perfect fitting between implant connection system and prosthetic structures.

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The predictability of the fixture placement can be enhanced using current technologies, namely, computer-aided design (CAD) and computeraided manufacturing (CAM) during pre-surgical planning.

CAD/CAM workflow allows the clinician to combine multiple data before surgery, such as tridimensional (3D) radiographies, anatomical structures data, intraoral and extraoral volume scans, mandible movements, and additional information that can enhance rehabilitation quality.

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however, fixtures are placed in order to primarily respect residual bone crest and rehabilitation esthetics , with marginal attention to the structures recorded by piezography.

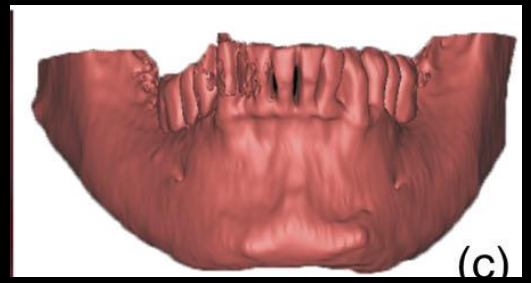
The magnitude of this oversight is often underestimated during the surgical planification, but it comes highly severe after denture placement, causing annoying problem for both clinicians and patients such as biting of tongue, lip, or cheeks, patient discomfort, or problems with.

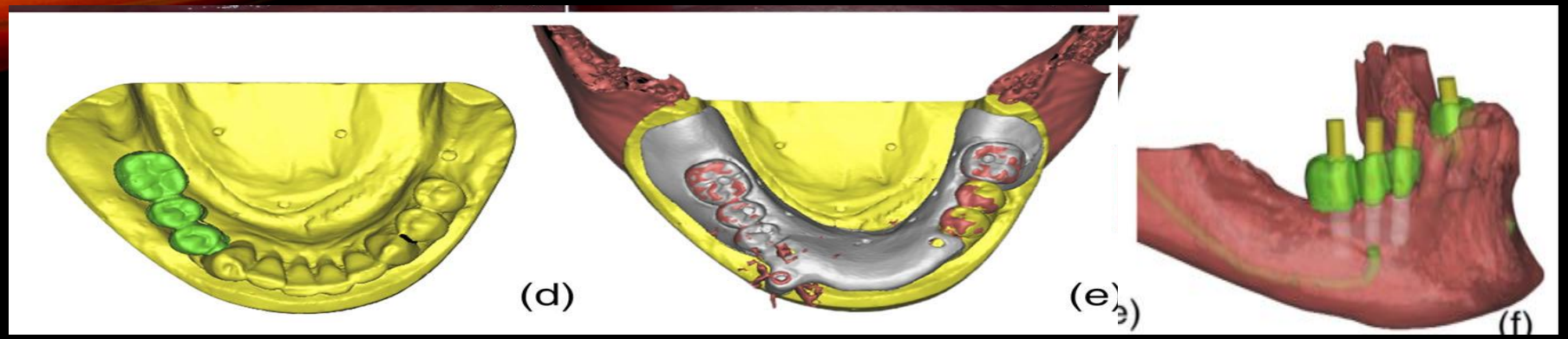
Interestingly, a recent case report described the fabrication of full-arch CAD/CAM rehabilitation using NZ data in order to mold the denture volume in the nonconflict area, thus increasing its stability as well as patient satisfaction and achieving a more physiologically integrated rehabilitation.

(a) Patient involved in the study. The tongue overrun edentulous space.

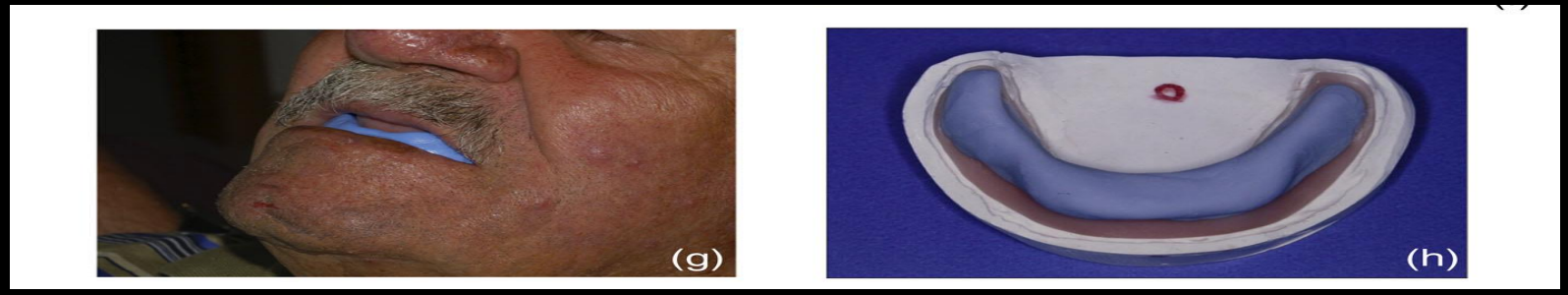
b) Radiographic guide check on edentulous arch.

(c) Cone beam–computed tomography 3D rendering.

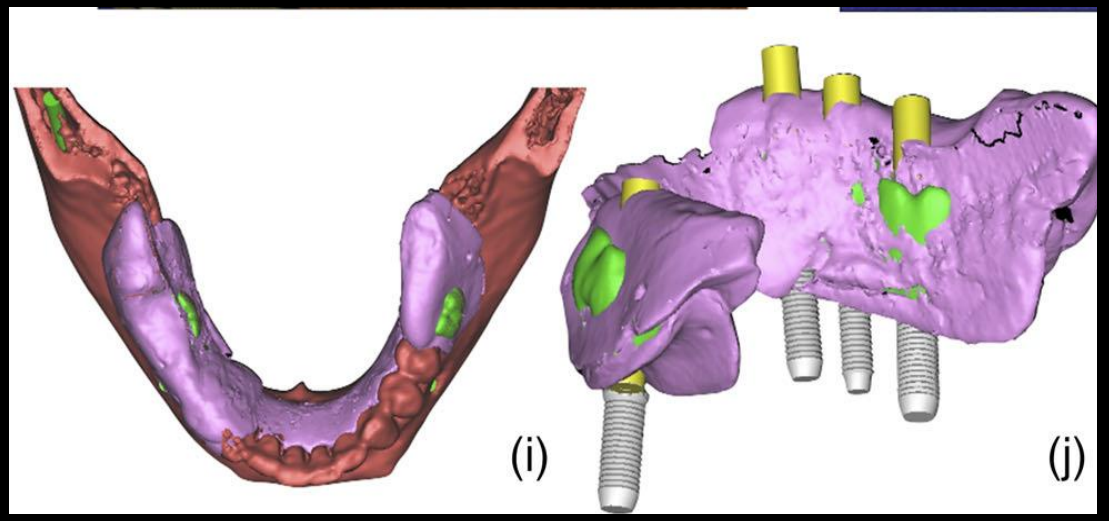




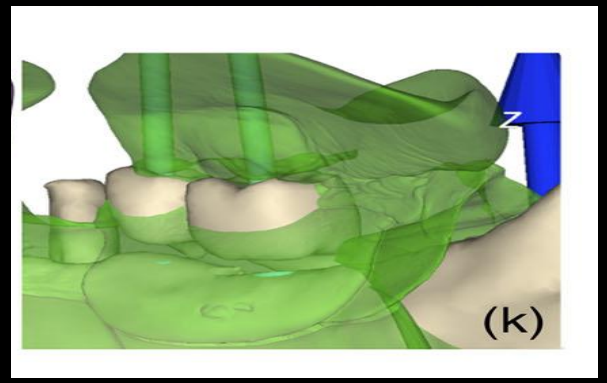
(d) Optical scan data.
(e) Integration of surface anatomical data, from surface scanner, and 3D radiographic data.
(f) Computer and prosthetic guided implant planning.



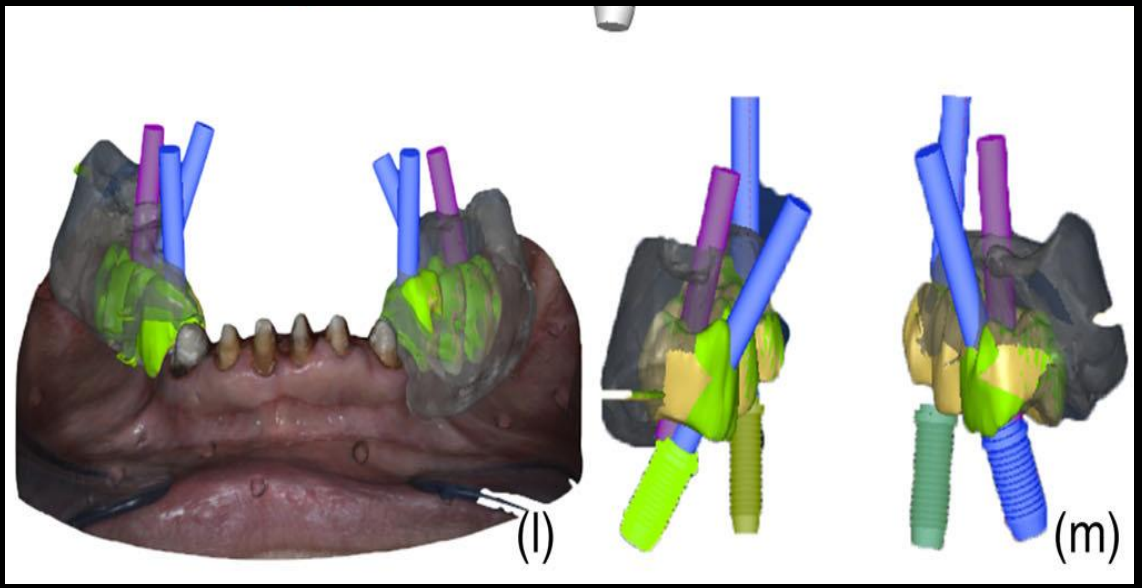
(g) Neutral zone (NZ) registration procedures.
(h) Piezographic record on its model.



(k) Traditional teeth arrangement does not respect NZ on the lingual side.

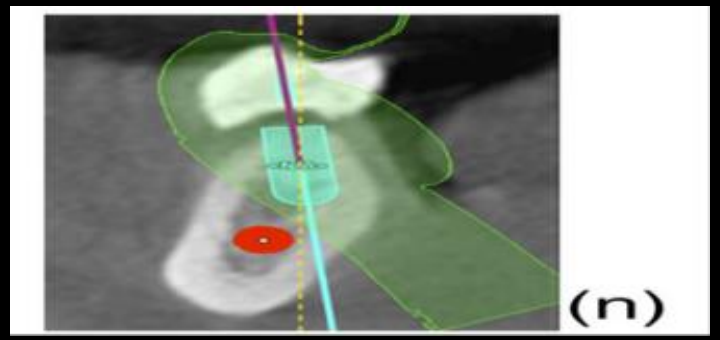


(i) NZ registration integrated in the virtual environment using the model cast as reference.
(j) Implant planning based on piezographic data.



(l,m) Differences of implant axes planned on traditional teeth arrangement technique (in blue) and on piezographic data (in violet).
Note the invasion of conflict zone by tooth of radiographic Template .

(n) Piezography-based implant planning in cross-sectional view. The software generates angular measurement referring to the dotted line, which is perpendicular to occlusal plane.



Most of the traditional prosthetic techniques only consider static evaluations, such as arrangement of posterior denture teeth directly over the crest of the edentulous ridge. As such, they ignore the impact of neuromuscular activity, which develops during childhood and then changes throughout life, on rehabilitation outcomes.

Dynamic functions, indeed, remain highly individual also in the edentulous patient and influence the performance of any rehabilitation device placed in the mouth

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NZ improve prosthesis stability, as well as phonation and soft tissue support accordingly. The angular deviation of fixture planning axis provides accurate quantification of the amount of NZ invasion by traditional prosthetic design.

The functionality of a dental prosthesis with respect to biomechanical and esthetic characteristics requires a well-designed implant positioning.

The prosthetic design, in fact, is substantially determined by the implant position, and this cannot be changed after surgery. In particular, implant axes affect crown profiles emergence, as well as occlusion dynamics and oro-lingual position.

- The described approach offers several advantages.
- First, it personalizes the analysis of the prosthetic space with regard to fixtures positioning.
- Second, the accurate preliminary assessment of both hard and soft peri-implantar tissues allows the precise determination of the available prosthetic space and the choice of the appropriate implant system and prosthetic components.

- In turn, an accurate reconstruction of oral surfaces improves outcome predictability following implant placement.

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An additional advantage of piezography in digital planning is that of relying on objective parameters rather than subjective visual perceptions during the reconstruction process. Most importantly, the proposed approach can particularly assist the clinician in the rehabilitation of the edentulous patients.

After natural teeth loss, in fact, the potential denture space lies within the mouth between the tongue thrust, pressing outward, and the forces of the cheeks and lips, pressing inward. The potential denture space in long-time edentulous arches is therefore different from dentate condition, as a consequence of muscular activity adaptation. Thus, the prosthetic teeth should be placed on edentulous arches according to individual neuromuscular function.

- In conclusion, piezography appears as an effective additional technique in customized implant planning and implant-supported prosthesis manufacturing, and the piezography-incorporating approach allows a significantly different management of the NZ compared with traditional digital planning.

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