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## 1 IMPORTANCE OF SOFT TISSUE AND HARD TISSUE LANDMARKS IN PROSTHODONTICS

Abstract Soft and hard tissue landmarks play a pivotal role in prosthodontics, influencing esthetics, function, phonetics, and stability of dental prostheses. Accurate identification and utilization of these landmarks are essential for proper tooth positioning, occlusal plane orientation, and overall patient satisfaction. With the advent of advanced imaging techniques, clinicians now have enhanced tools to assess both soft and hard tissue anatomy with greater precision. This article explores the clinical relevance, methods of evaluation, and applications of these

landmarks in denture fabrication and prosthodontic rehabilitation, integrating current research and evidence-based practices. Introduction Facial appearance significantly affects self-esteem, social interactions, and quality of life. Patients seeking prosthodontic treatment often prioritize improvement in facial esthetics alongside functional restoration.

Traditionally, prosthodontic treatment planning emphasized hard tissue landmarks, such as alveolar ridges, maxillary tuberosities, and palatal contours, due to their reproducibility and ease of palpation. However, there has been a paradigm shift towards incorporating soft tissue landmarks—such as lips, cheeks, and facial contours—as they more accurately reflect esthetic outcomes and influence the final prosthetic result.<sup>1</sup> Two-dimensional cephalometry, once the gold standard in craniofacial assessment, focuses primarily on bony landmarks. While reproducible, it lacks the capacity to capture the intricate contours and dynamic relationships of soft tissues. Three-dimensional imaging systems, including cone-beam computed tomography (CBCT), facial surface laser scanning, and 3D stereophotogrammetry, now provide detailed visualization of facial soft tissue, offering a more holistic approach to diagnosis, planning, and treatment evaluation in prosthodontics.<sup>2</sup>

## 2

Soft tissue analysis using stereophotogrammetry involves marking anatomical points manually on 3D facial images. Although palpation is not possible in this method, studies have

demonstrated reproducibility for specific landmarks such as the nasion, pronasale, labrale superius, labrale inferius, and soft tissue pogonion. The accuracy of these landmarks is crucial for planning esthetic anterior tooth positioning and occlusal plane orientation.

**Evaluation of Soft Tissue Landmark Reliability** Identifying soft tissue landmarks accurately is essential for reproducible prosthodontic

treatment planning. Several studies have compared manual and computerized plotting methods for landmark localization. In one study, 50 lateral cephalograms of pretreatment patients were evaluated for 10 soft tissue landmarks, plotted both manually using acetate tracing sheets and digitally using software such as Dolphin Imaging 2. Manual plotting involves tracing anatomical landmarks on acetate sheets overlaid on radiographs, followed by transferring measurements to graph sheets. While effective, manual plotting is time-consuming and prone to inter- and intra-observer variability. Digital plotting, in contrast, allows on-screen landmark identification and precise measurement along X and Y axes, improving reproducibility. Five commonly used soft tissue landmarks include: 1.

**Soft Tissue Nasion (STN):** The deepest concavity in the midline between the forehead and nose, crucial for nasal region evaluation. 2. **Tip of Nose (TN or Pronasale):** The most anterior point of the nose, guiding nasal esthetics and upper lip positioning. 3.

**Upper Lip (UL or Labrale Superius):** Represents the anterior-most point of the upper lip at the mucocutaneous junction. 4. **Lower Lip (LL or Labrale Inferius):** Median point on the lower lip margin, critical in evaluating lip competence and occlusal relationships. 5.

**Soft Tissue Pogonion (STP):** Most anterior point on the chin, used to assess chin prominence and mandibular contour. Studies indicate that computerized digital plotting is more consistent than manual methods, particularly for landmarks that are difficult to palpate. Accurate soft tissue assessment is vital not only for esthetic evaluation but also for functional considerations such as lip support, phonetics, and smile design<sup>2</sup>.

**Anatomic Landmarks in the Maxilla for Anterior Tooth Positioning** Proper positioning of anterior teeth in prosthodontics is guided by both hard and soft tissue landmarks. The anterior maxilla provides reliable anatomical reference points for establishing

3 the ideal position of maxillary central incisors, which are central to esthetics, speech, and masticatory function.

A study analyzing 60 adult skulls with intact anterior dentition measured the distance from the labial surface of the maxillary central incisor to the posterior wall of the incisive foramen, the distance from the posterior wall of the incisive foramen to the distal portion of the posterior nasal spine, and the width of the maxillary central incisors. Results showed that the distance

from the central incisor to the posterior wall of the incisive foramen was relatively constant at approximately 15 mm, providing a reliable guideline for anterior tooth positioning<sup>3</sup>. Such anatomical measurements are critical during denture fabrication, as improper anterior tooth placement can lead to poor esthetics, compromised speech, and difficulty in mastication.

These landmarks help recreate natural proportions, guide incisal edge positioning, and maintain functional harmony in the oral cavity<sup>3</sup>. **Occlusal Plane**

The occlusal plane is the imaginary plane formed by the incisal and occlusal surfaces of teeth. Its accurate orientation is crucial for denture stability, esthetics, phonetics, and masticatory efficiency. In edentulous patients, recreating the natural occlusal plane is one of the most critical steps in prosthodontic rehabilitation<sup>4</sup>. **Anterior Occlusal Plane** In the anterior region, the occlusal plane is primarily determined by esthetic requirements. It should follow the curvature of the lower lip at rest and during smiling to achieve a natural appearance. Speech articulation also assists in positioning the anterior occlusal plane correctly. Clinically, the anterior plane should be parallel to the interpupillary line when viewed from the front.

**Posterior Occlusal Plane** Several landmarks assist in establishing the posterior occlusal plane: □

□ **Parotid Papilla:** Located adjacent to the maxillary second molar, approximately 3–6 mm above the occlusal plane. It serves as a reproducible landmark in edentulous patients<sup>4</sup>. □

□ **Hamular Notch–Incisive Papilla (HIP) Plane:** Provides a stable reference for orienting the occlusal plane. Studies have shown parallelism between the HIP plane and the natural occlusal plane, making it a reliable intraoral landmark<sup>6</sup>. □

□ **Retromolar Pad:** Also

known as the piriformis papilla, it remains stable after molar resorption and can guide posterior occlusal plane orientation. However, its soft tissue nature and indistinct borders limit its use in tooth-supported full-mouth rehabilitation<sup>8</sup>. □ Lateral Border of Tongue: Can be used in neutral zone techniques but is highly variable due to tongue mobility and hypertrophy following tooth loss<sup>10</sup>.

4 □ Commissure of Lips: The corners of the mouth provide dynamic references for the occlusal plane. Studies indicate that the commissure line aligns within 0.2–1.3 mm of the natural occlusal plane<sup>5</sup>. □ Buccinator Groove: Vestibular impressions reveal that the occlusal plane generally coincides with the buccinator groove in patients with good muscle tone, though age-related muscle changes may affect its reliability<sup>4</sup>. Extraoral Landmarks Extraoral landmarks provide additional guidance for establishing occlusal planes, particularly in edentulous patients: □

Interpupillary Line: Horizontal line connecting the centers of the pupils. The anterior occlusal plane should ideally be parallel to this line<sup>6</sup>. □ Ala-Tragus Line (Camper's Plane): Drawn from the inferior border of the ala of the nose to the tragus of the ear, this line guides posterior occlusal plane orientation<sup>7</sup>. Studies show that parallelism between the occlusal plane and Camper's plane is observed in most patients, though variations exist depending on reference points on the tragus<sup>8</sup>. □ Ear Lobe: Occasionally used as a secondary reference for occlusal plane orientation<sup>8</sup>. Supporting Structures in the Maxilla

The stability and support of maxillary dentures depend on the underlying hard and soft tissues: □ Hard Palate: Comprised of the palatine processes of the maxilla and palatine bones, the hard palate provides primary support for dentures<sup>9</sup>. The mucosa is keratinized and resistant to resorption, ensuring durability. □ Rugae: Dense connective tissue folds in the anterior third of the palate provide secondary support, aiding in denture retention and stability<sup>10</sup>. □ Residual Ridge: The alveolar ridge remaining after tooth extraction is a critical stress-bearing area<sup>11</sup>. Its crest provides primary support for dentures, while lateral aspects serve as secondary stress-bearing zones. Clinical Significance The identification and utilization

of both soft and hard tissue landmarks have direct clinical implications: 1.

**Esthetics:** Accurate landmark assessment ensures harmonious tooth positioning, proper lip support, and a natural smile line<sup>7</sup>.

5 **2. Function:** Correct occlusal plane orientation and anterior tooth placement enhance mastication, phonetics, and denture stability<sup>12</sup>. 3.

**Prosthesis Design:** Landmarks guide anterior and posterior tooth arrangement, influencing occlusion, articulation, and prosthetic biomechanics. 4.

**Patient Comfort:** Properly aligned dentures reduce the risk of tongue or cheek biting, speech difficulty, and discomfort. Modern prosthodontics integrates 3D imaging, digital planning, and anatomical knowledge to

achieve predictable outcomes. By combining intraoral and extraoral landmarks, clinicians can replicate natural occlusion and facial esthetics in edentulous and partially edentulous patients<sup>13</sup>.

**Conclusion** Soft and hard tissue landmarks are indispensable tools in prosthodontics. The accurate identification and application of these landmarks enhance esthetic outcomes, functional efficiency, and overall patient satisfaction. Advances in digital imaging and 3D analysis have improved reproducibility and precision in landmark identification. Clinicians must integrate both soft and hard tissue assessment with clinical judgment to achieve optimal prosthetic rehabilitation. **References** 1. Al Quran FA, Hazza'aA, Al Nahass N

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