ORIGINAL RESEARCH ORİJİNAL ARAŞTIRMA

DOI: 10.5336/dentalsci.2024-107808

The Evaluation of Lip Support Provided by Dentures in Patients Using Maxillary Complete Dentures: An Experimental Study

Üst Tam Protez Kullanan Hastalarda Protez Tarafından Sağlanan Dudak Desteğinin İncelenmesi: Deneysel Çalışma

Adnan ŞAHİN[a], Doruk ALTIOK[a], Caner İNCEKAŞ[b], Cem ÇETİNŞAHİN[c]

[a]Başkent University Faculty of Dentistry, Department of Prosthodontics, Ankara, Türkiye
[b]Başkent University Faculty of Medicine, Department of Biostatistics, Ankara, Türkiye
[c]Private Dentist, Ankara, Türkiye

ABSTRACT Objective: The objective of this study was to determine the lip support gained by complete upper dentures using the nasolabial angle (NLA) parameter before and after the prosthesis insertion. **Material and Methods:** 31 patients with complete edentulism were included in the study. The epidemiological characteristics and etiology/period of edentulism were recorded. The patients received dentures made by the same 2 clinicians and the dental laboratory. Pre-treatment and post-treatment profile photographs were taken and NLA measurements were made. The conformity of the variables to normal distribution was analyzed by Shapiro-Wilk test. Dependent sample t-test was used to evaluate normally distributed variables between 2 dependent measurements. Repeated measures analysis of variance test was used to determine whether the NLA measurement changed according to gender, age, etiology, and duration of edentulism groups. Differences between groups were determined by Tukey's honestly significant difference test. p values below 0.05 were considered as statistically significant. **Results:** The mean baseline measurement of NLA was 97.39±11.45, the mean final measurement was 89.36±10.63. NLA decreased significantly in the final measurement. The decrease of NLA is greater in males, however the difference in age and etiology groups were not significant. **Conclusion:** It can be stated that complete upper dentures positively affect lip support however the relation between NLA gained and epidemiological characteristics needs further investigation.

Keywords: Complete upper denture; prosthodontics; denture design; dental care for aged

ÖZET Amaç: Bu çalışmanın amacı, üst total protezlerin sağladığı dudak desteğini protez öncesi ve sonrası nazolabial açı (NLA) parametresini kullanarak belirlemektir. **Gereç ve Yöntemler:** Tam dişsizliği olan 31 hasta çalışmaya dâhil edildi. Epidemiyolojik özellikler ve dişsizlik etiyolojisi/süresi kaydedildi. Hastalara aynı 2 klinisyen ve diş laboratuvarı tarafından protezler yapıldı. Tedavi öncesi ve sonrası profil fotoğrafları çekildi ve NLA ölçümleri yapıldı. Değişkenlerin normal dağılıma uygunluğu Shapiro-Wilk testi ile analiz edildi. Bağımlı örneklem t-testi, 2 bağımlı ölçüm arasındaki normal dağılımlı değişkenleri değerlendirmek için kullanıldı. NLA ölçümünün cinsiyet, yaş, etiyoloji ve dişsizlik süresi gruplarına göre değişip değişmediğini belirlemek için tekrarlı ölçümlerde varyans analizi testi kullanıldı. Gruplar arasındaki farklılıklar Tukey's HSD testi ile belirlendi. 0,05'in altındaki p değerleri istatistiksel olarak anlamlı kabul edildi. **Bulgular:** NLA'nın ortalama başlangıç ölçümü 97,39±11,45, ortalama son ölçümü 89,36±10,63 idi. NLA son ölçümde anlamlı olarak azalmıştır. NLA'daki azalma erkeklerde daha fazladır, ancak yaş ve etiyoloji grupları arasındaki fark anlamlı değildir. **Sonuç:** Tam üst protezlerin dudak desteğini olumlu yönde etkilediği söylenebilir ancak kazanılan NLA ile epidemiyolojik özellikler arasındaki ilişkinin daha fazla araştırılması gerekmektedir.

Anahtar Kelimeler: Üst tam protez; prostodonti; protez dizaynı; yaşlılarda diş bakımı

Correspondence: Doruk ALTIOK
Başkent University Faculty of Dentistry, Department of Prosthodontics, Ankara, Türkiye
E-mail: dorukaltiok@gmail.com

Peer review under responsibility of Turkiye Klinikleri Journal of Dental Sciences.

Received: 03 Jan 2025 ***Received in revised form:*** 29 Jan 2025 ***Accepted:*** 30 Jan 2025 ***Available online:*** 03 Jun 2025

Complete edentulism is still an everyday case the dentists encounter and treat accordingly. In 2014, it was reported that 2.3% of the worldwide population (~158 million people) was edentulous.[1] Tooth loss that leads to complete edentulism can be caused by caries, periodontal factors, systemic factors or socioeconomic factors.[2,3] Even though the causes can be different, the treatment options are mostly similar in all the cases; complete dentures, implant retained overdentures or implant retained fixed/hybrid prosthesis. The treatment options can be narrowed down to an ideal treatment course pertaining to the intraoral situation and patients' finances.

As the teeth are progressively lost, both the intra- and extraoral tissues are subject to alterations. The maxillary alveolar process' labial/buccal aspects resorb to the palatal aspect and the mandibular alveolar process the lingual aspects resorb to the labial/buccal aspect, thus creating a pseudo-mandibular prognathism. Other changes caused by total edentulism include a decrease of the vertical dimension and corresponding facial height causing the chin to become closer to the nose.[4] A separate consequence of the direction of this resorption is the loss of lip support and the increase in the nasolabial angle (NLA).

The lost lip support can be restored with the help of the prosthesis design. However since only the labial flanges can replace the resorbed alveolar bone, only removable prosthesis designs, i.e. complete dentures and overdentures, can reinstate the lip support decreasing the NLA.[5]

The amount of pre-treatment lip support and the desired post-operative lip support determines the modality of the prosthesis.[6-8] The amount of lip support provided may be influenced by the arch shape, the position of the incisors, cervical edge contours and the resorption amount.[7,8] To analyze the lip support a baseplate and wax rim labial flange can be used. The lip support can be observed with and without this labial flange and thus the treatment options can be discussed accordingly.[9]

The main objective of this research is to evaluate the changes in the NLA after providing the patients with an upper complete denture. The change in the NLA as a facial marker may be able to provide a numerical value for the change in lip support provided with an upper complete denture. To the best of the authors' knowledge there are no studies showing an average numerical change in NLA and lip support with the use of complete upper dentures. The null hypothesis of this study is that the complete upper dentures do not provide a significant change in NLA/lip support.

MATERIAL AND METHODS

This study was conducted at Başkent University Faculty of Dentistry, Department of Prosthodontics. This study was approved by Başkent University Institutional Review Board and Ethics Committee (tarih: 2 Ağustos 2023; no: D- KA23/15). The study was conducted in accordance with the Declaration of Helsinki principles.

The inclusion criteria for this study were appointed as patients with total edentulous maxilla using complete dentures. Informed consent was obtained from the patients, a complete dental and medical history was taken, intraoral and extraoral examinations were performed and the etiological factors for edentulism were recorded. Extraoral profile photographs were taken in accordance with the informed consent form. Thirty-one patients were included in the study.

In this study, complete dentures with acrylic bases were produced in order to treat total edentulism by 2 clinicians; AŞ and DA. A competent dental technician using the same materials at a qualified dental lab produced all of the prostheses.

To compare the pre-treatment and post-treatment NLAs, side profile photographs of the patients with and without the prostheses were taken using a digital single-lens reflex camera (Canon 750D, Canon Inc., Japan) and a suitable macro lens (Canon Macro Lens EF 100 mm/1:2.8 L IS USM, Canon Inc., Japan) with the settings set at 1/200/F16/ISO 200. In order to standardize the photographs, a tripod was used to affix the camera at a set 3 meters distance at a predetermined point at the same dental unit. The patients' ala-tragus lines were positioned to be parallel to the ground in order to standardize the posture (Figure 1). The ala-tragus line was selected for the standardization, as the natural head position may not

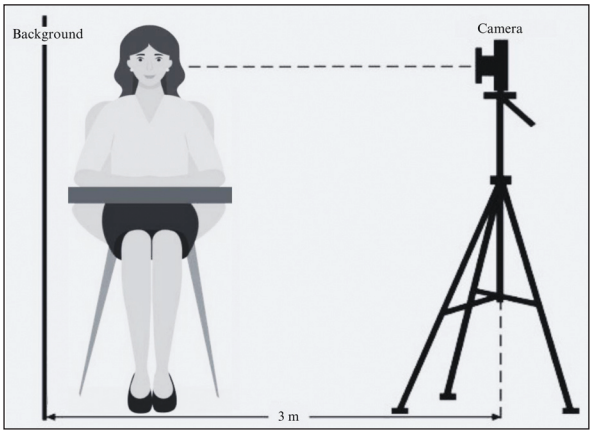

FIGURE 1: Figure depicting the standardization of the posture and the camera positioning

always result in a true horizontal plane because of its variability, which may hinder the standardization.[10] The NLA measurements were made with the help of the AutoCAD (Autodesk, USA) software. The NLA was measured using the orthodontic standard points of pronasale, subnasale and labialis superioris.[11]

The power analysis was conducted using the G*Power software (Düsseldorf, Germany) using the inputs as follows; α=0.05, 1-β=0.95, dz=0.617.

Statistical analyses were performed with SPSS version 25.0 software (IBM, Armonk, NY, USA). The conformity of the variables to normal distribution was analyzed by Shapiro-Wilk test. Mean, standard deviation, median, minimum and maximum values were used for descriptive analyses. Frequency and percentage values of the variables were used when presenting categorical variables. Dependent sample t-test was used to evaluate normally distributed variables between 2 dependent measurements. Repeated measures analysis of variance test was used to determine whether the NLA measurement changed according to gender, age, etiology, and duration of edentulism groups. Differences between groups were determined by Tukey's honestly significant difference test and p-values below 0.05 were considered as statistically significant results.

RESULTS

The power analysis at 80% confidence gave a result of 23 patients and the study included 31 patients. 64.52% of the patients were male. 6.45% of the patients were 40-50 years old, 12.9% were 50-60 years old, 41.94% were 60-70 years old, 35.48% were 70-80 years old and 3.23% were 80 years old or older. The etiology of edentulism was classified as periodontal disease (58.06%), extraction due to caries (32.26%) and trauma (9.68%). The duration of edentulism was 0-5 years in 41.94%, 5-10 years in 9.68%, and 10 years or more in 48.39% of the patients (Table 1).

The mean baseline measurement of nasolabial angle was 97.39±11.45, while the mean final measurement was 89.36±10.63. Nasolabial angle decreased significantly in the final measurement (Table 2).

In Table 3 and Figure 2, NLA Pre-treatment and NLA Post-treatment values were compared according to gender, etiology, age groups, and different time periods. According to the analysis results, the time factor (the difference between NLA pre-treatment and NLA post-treatment) was found to be significant overall (p<0.001). Regarding gender, the time factor

TABLE 1: Table showing the distribution of the patients' characteristics, i.e. gender, etiology of edentulism, age and edentulism period

		n	%
Gender	Female	11	(35.48)
	Male	20	(64.52)
Etiology	Periodontal	18	(58.06)
	Caries	10	(32.26)
	Trauma	3	(9.68)
Age	40-50 years	2	(6.45)
	50-60 years	4	(12.90)
	60-70 years	13	(41.94)
	70-80 years	11	(35.48)
	80 years and over	1	(3.23)
Period	0-5 years	13	(41.94)
	5-10 years	3	(9.68)
	10 years and over	15	(48.39)

TABLE 2: The changes in pre- and post-operative NLA calculated with dependent 2 sample t-test

	X̄±SD	Median (minimum-maximum)	p value
NLA pre-operative	97.39±11.45	99.5 (69.3-118.2)	<0.001
NLA post-operative	89.36±10.63	87.4 (70.2-108.2)	

SD: Standard deviation; NLA: nasolabial angle

TABLE 3: The changes in pre- and post-operative NLA according to the groups calculated with analysis of variance in repeated measures

		NLA Pre-treatment		NLA Post-treatment		p value	p value	p value
		X̄±SD	Median (minimum-maximum)	X̄±SD	Median (minimum-maximum)	(time)	(group)	(time* group)
Gender	Female	94.69±14.78	98.9 (69.3-118.2)	89.95±11.63	94.2 (73.9-108.2)	**<0.001**	0.685	**0.036**
	Male	98.88±9.24	100.3 (79.5-114.8)	89.05±10.35	86.75 (70.2-104.6)			
Etiology	Periodontal	99.58±12.16	101.95 (77.8-118.2)	91.75±12.55	96.05 (70.2-108.2)			
	Caries	94.01±11.11	99.45 (69.3-106.8)	85.81±6.89	85.3 (73.9-96.6)	**<0.001**	0.371	0.976
	Trauma	95.57±6.96	98.1 (87.7-100.9)	86.9±4.52	84.7 (83.9-92.1)			
Age	40-50 years	99.75±17.04	99.75 (87.7-111.8)	91.25±9.26	91.25 (84.7-97.8)			
	50-60 years	92.9±9.81	95.6 (79.5-100.9)	81.38±7.49	81.75 (72.1-89.9)			
	60-70 years	99.28±9.27	103.1 (77.8-107.3)	93.21±10.60	95.5 (76.3-104.6)	**<0.001**	0.585	0.509
	70-80 years	96.18±14.70	98.5 (69.3-118.2)	86.73±10.99	86.1 (70.2-108.2)			
	80 years and over	99.4±.	99.4 (99.4-99.4)	96.6±.	96.6 (96.6-96.6)			
Period	0-5 years	100.67±9.14	103.1 (79.5-111.8)	94.07±10.73	97.8 (72.1-104.6)			
	5-10 years	101.83±4.30	99.5 (99.2-106.8)	88.93±5.66	87.4 (84.2-95.2)	**<0.001**	0.137	0.328
	10 years and over	93.67±13.32	98.1 (69.3-118.2)	85.37±10.07	84.5 (70.2-108.2)			

SD: Standard deviation

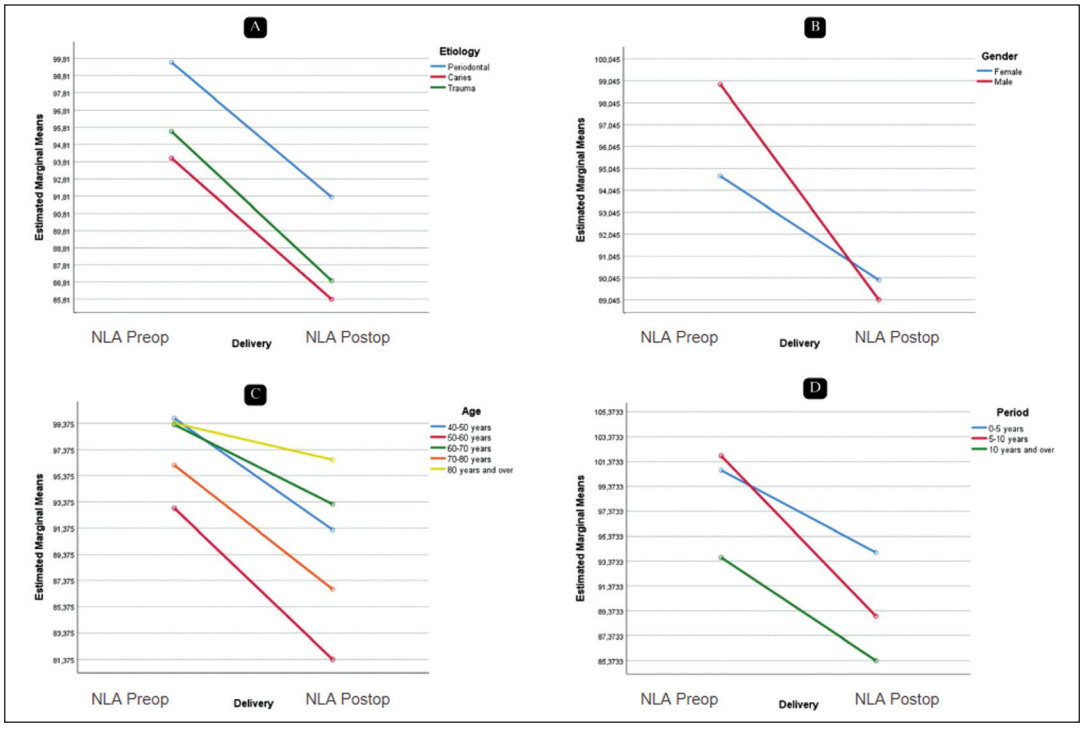

FIGURE 2: Figure showing the changes in the NLA before and after the delivery of the complete denture according to the patients' characteristics.
A) Etiology of edentulism; **B)** Gender; **C)** Age; **D)** Edentulism period

was significant (p<0.001), whereas no significant difference was observed between groups (p=0.685). However, the time*group interaction was significant (p=0.036). This indicates that NLA measurements decreased over time, but this decrease was similar across genders. Additionally, the decrease in males was significantly greater compared to females.

In terms of etiology, the time factor was found to be significant (p<0.001), while no significant difference was observed between groups (p=0.371), and

the time*group interaction was not significant (p=0.976). This indicates that NLA measurements showed a significant decrease over time, but this decrease was similar across the etiology groups.

In terms of age, the time factor was found to be significant (p<0.001), while no significant difference was observed between groups (p=0.585), and the time*group interaction was not significant (p=0.509). This indicates that NLA measurements showed a significant overall decrease over time, but this decrease was similar across all age groups.

In terms of period, the time factor showed a significant difference (p<0.001), whereas no significant difference was observed between groups (p=0.137) or in the time*group interaction (p=0.328). This indicates that NLA measurements showed a significant overall decrease over time, but this decrease was similar across all period groups.

DISCUSSION

With the results of this current study, the null hypotheses were rejected. The complete upper dentures provide a statistically significant change in the lip support. An average decrease of 8° of NLA is recorded in this study.

The bones in the human body are subjected to a continuous process of deposition and resorption, remodeling, which is governed by the functional matrix theory explained by Enlow.[12] This functional matrix theory states that the governing tissues of osteogenic remodeling are the surrounding soft tissues and the dental tissues connected to the alveolar ridges by the Sharpey fibers.[12] As humans age, the tonus of the muscles decrease and the teeth may be lost due to several reasons. These changes coupled with the etiological factors for edentulism causes the bone remodeling to shift its' equilibrium to the side of resorption.

However, edentulism and the loss of muscular tonus are not the sole reasons for alveolar bone resorption. According to the longitudinal study of 25 years by Tallgren (1972), the anterior height of the alveolar ridges continues to decrease with the use of complete dentures. It is stated in this article that the alveolar resorption reaches its' maximum level at the first year, but it still continues after 25 years. The alveolar ridge lost in the mandible is stated to be 4 times higher than in the maxillary alveolar ridge.[13] Thus, it can be said that the external forces acting on the alveolar bone also causes continuing bone resorption.

After severe resorption of the alveolar ridge, the facial contours are also subject to change as the facial vertical dimensions decrease and the pseudoprognathic appearance is reached.[4,14] The cephalometric study by Palac et al. also shows the effects of complete dentures used for 5 years. The occlusal plane/Frankfort Horizontal angle's, ANB angle's and the SN/Go-Gn angle's changes support the facts that the lower facial height is reduced, the occlusal plane shows anterior rotation and maxillomandibular relation becomes more prone to Class III relation.[14] However, it is imperative that the clinician should not forget that these changes also affect the supporting soft tissues as well, such as a decrease in the lip support and the corresponding NLA. New studies are being conducted to estimate these resorptive changes and their post-operative changes after delivering the denture.[15]

It is no surprise that the patients' needs do not end with just providing function.[16] Esthetics, in case of total edentulism, consists of restoring the facial contours as well as dental esthetics. The combination of dental and facial esthetic needs can be rehearsed at the production stages of the denture and then be attuned to the patients' special needs with the help of impressions and wax rims.[17] At the border molding stage it was thought that the "rolled borders" would create a sufficient support for the lips but Besford&Sutton in their 2018 paper state that the thinness of the labial flange can help the silhouette of the lip to return back to its' pre-extraction state.[9,17] After tuning the wax rims to create an ideal lip support, then a decision can be made about the existence of labial flanges. However; in order to create a lip support, a labial flange is recommended most of the times, thus creating the need for a denture or an overdenture.[17] If the patient's needs do not include a labial flange, then a fixed prosthesis can be the first option. As opposing to creating the ideal situation for the patient, sometimes a patient may choose to have what

he/she became used to in the years. In these situations, a duplicate denture with the same polished surface and flanges as the patient's previous denture should be created.[18]

In this study, the first parameter to be researched was the etiological reasons for the patients' edentulism. Untreated periodontitis may cause severe bone resorption as it is an inflammatory disease with infectious characteristics compromising the whole periodontium. However, the extraction of teeth due to caries may not result in such an amount of alveolar resorption.[19] The other parameters that were looked into were host-dependent epidemiological factors, i.e. gender, sex, age and edentulism period.

As the patients' baseline alveolar contours are examined in the etiologies sub-group (Figure 2; Table 3), the periodontal tooth extraction has the largest results in pre-op NLA measurements followed by trauma and caries. This sorting, although not significant, shows the consequence of extraction etiology to the NLA. The detrimental effects of periodontal disease to the alveolar bone are laid bare by this result.

The difference of NLA within the different etiology groups were significant in their respective group, however a significant change was not observed between the groups. This shows that the etiology may affect the quantity of resorbed bone as stated by previous studies, however it does not affect the lip support gained by the dentures.[19] This finding may be counterintuitive, however; given the unequal distribution of the sample sizes of each etiological groups, this may be explained. There is a need of further studies in order to fully explain the relationship between the etiological factors of tooth loss and lip support lost and/or gained.

An unanticipated result came to be when examining the difference in NLA of a skeletally Class III patient (Figure 3). This result shows that the NLA pre-delivery was 69.3° however after the delivery of the denture, the NLA was read at 73.9°. This increase in NLA is an exception from the other results, as it is the only case in which the NLA has increased. This exceptional result is also a contradictory one due to the time-held fact that the flanges of a denture increase the lip support. However, in this case the soft tissue profile may provide a key for this unusual case. If the upper vermillion line and the profile of the upper lip is observed, it can be seen that in the pretreatment photos, the upper lip is curled anteriorly due to the missing lip support thus pushing the labialis superioris point superoanteriorly. When the denture is delivered however, the upper lip's curled state

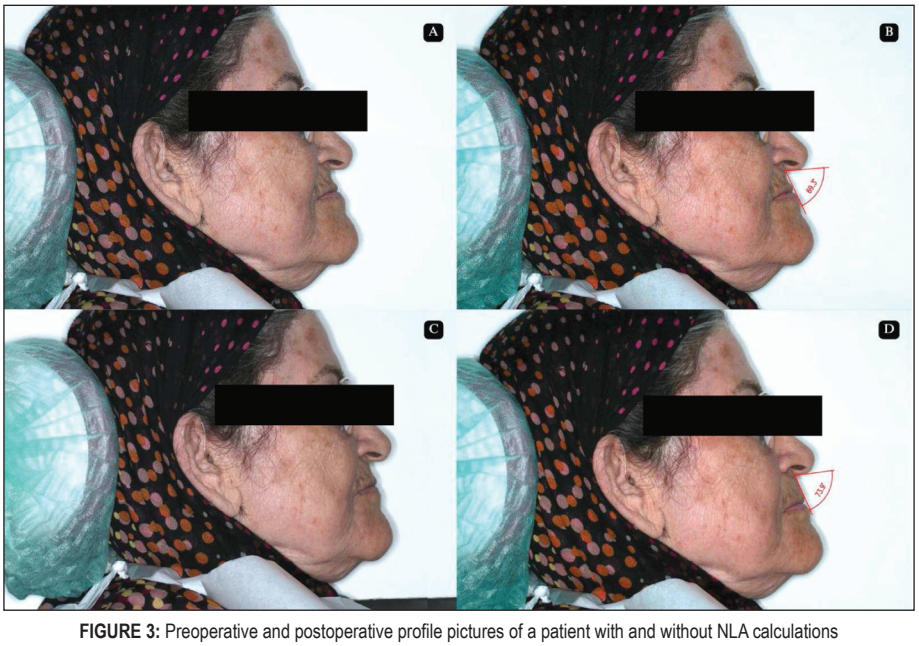

FIGURE 3: Preoperative and postoperative profile pictures of a patient with and without NLA calculations

reverts to a more straight position with the lip support gained thus moving the labialis superioris point inferoposteriorly relative to the pre-treatment state. This change in the reference point's location can explain the increase in NLA. This result proves that the soft tissues' changes are not solely dependent on only one factor, they are the combined result of the responses of the whole stomatognathic system.

As the dental procedures become more and more dependent on digital planning, the role of capturing the facial esthetics while planning a case is a daily struggle most of the clinicians face. Although it is not current paradigm, digital complete denture planning and production is a popular topic among clinicians and researchers alike. Creating a copy of the patient *in-silico* or as Joda&Galluci named in 2015 "the virtual patient" is becoming a standard of the planning phase of dental treatment, it is inevitable for the dentures to be planned and produced using a full digital workflow in the near future.[20] As artificial intelligence models become more advanced, their role in digital planning is also increasing. Their roles in restoration planning/designing and treatment simulations are beginning to be used extensively.[21] The numerical value of 8 degrees of NLA gained by complete upper dentures may help the manual or artificial intelligence based restoration planning as an average expected value.

The limitations of this study are the lack of cephalometric analyses and the standardization process of the photographs. The photographs can be standardized with the natural head position as the alatragus line/occlusal plane and horizontal plane relationships are debated. These results depict the need for further investigation in order to fully understand the relationship between the soft tissues and complete dentures. For a better understanding on the subject, cephalometric analyses are needed in the upcoming studies.

CONCLUSION

Within the limitations of the study, complete dentures' role in lip support has been solidified statistically. In addition, statistical analyses have shown that the complete dentures provide a statistically significant decrease of approximately 8 degrees in NLA without the need to consider the patients' age, gender, edentulism period or etiology of tooth extraction. According to this information, a clinician may plan the case with better foresight regarding the lip support. This numerical value for lip support gained may also aid in the digital planning procedures.

Acknowledgements

The authors would like to thank Tunç Altıok DDS, PhD for his comments and Çağla Süslüay for the language check.

Source of Finance

This study was supported way by Başkent University Research Fund (Project no: D- KA23/15).

Conflict of Interest

No conflicts of interest between the authors and / or family members of the scientific and medical committee members or members of the potential conflicts of interest, counseling, expertise, working conditions, share holding and similar situations in any firm.

Authorship Contributions

Idea/Concept: *Adnan Şahin, Doruk Altıok, Caner İncekaş, Cem Çetinşahin;* ***Design:*** *Adnan Şahin, Doruk Altıok, Caner İncekaş, Cem Çetinşahin;* ***Control/Supervision:*** *Adnan Şahin, Doruk Altıok, Caner İncekaş, Cem Çetinşahin;* ***Data Collection and/or Processing:*** *Adnan Şahin, Doruk Altıok, Caner İncekaş, Cem Çetinşahin;* ***Analysis and/or Interpretation:*** *Adnan Şahin, Doruk Altıok, Caner İncekaş, Cem Çetinşahin;* ***Literature Review:*** *Adnan Şahin, Doruk Altıok, Caner İncekaş, Cem Çetinşahin;* ***Writing the Article:*** *Adnan Şahin, Doruk Altıok, Caner İncekaş, Cem Çetinşahin;* ***Critical Review:*** *Adnan Şahin, Doruk Altıok, Caner İncekaş, Cem Çetinşahin;* ***References and Fundings:*** *Adnan Şahin, Doruk Altıok, Caner İncekaş, Cem Çetinşahin;* ***Materials:*** *Adnan Şahin, Doruk Altıok, Cem Çetinşahin.*

REFERENCES

1. Kassebaum NJ, Bernabé E, Dahiya M, Bhandari B, Murray CJ, Marcenes W. Global burden of severe tooth loss: a systematic review and meta-analysis. J Dent Res. 2014;93(7 Suppl):20S-28S. PMID: 24947899; PMCID: PMC4293725.
2. Passarelli PC, Pagnoni S, Piccirillo GB, Desantis V, Benegiamo M, Liguori A, et al. Reasons for tooth extractions and related risk factors in adult patients: a cohort study. Int J Environ Res Public Health. 2020;17(7):2575. PMID: 32283707; PMCID: PMC7178127.
3. Colares Maia L, de Melo Costa S, Reis Barbosa Martelli D, Prates Caldeira A. Total edentulism in older adults: aging or social inequality? Rev bioét (Impr). 2020;28(1):173-81. doi: 10.1590/1983-80422020281380
4. Jonasson G, Skoglund I, Rythén M. The rise and fall of the alveolar process: dependency of teeth and metabolic aspects. Arch Oral Biol. 2018;96:195-200. PMID: 30292055.
5. Bidra AS, Zapata G, Agar JR, Taylor TD, Grady J. Differences in lip support with and without labial flanges in a maxillary edentulous population. Part 1: Objective Analysis. J Prosthodont. 2018;27(1):10-6. PMID: 28561267.
6. Lago L, Rilo B, Fernández-Formoso N, DaSilva L. Implant rehabilitation planning protocol for the edentulous patient according to denture space, lip support, and smile line. J Prosthodont. 2017;26(6):545-8. PMID: 27662516.
7. Bidra AS. Three-dimensional esthetic analysis in treatment planning for implant-supported fixed prosthesis in the edentulous maxilla: review of the esthetics literature. J Esthet Restor Dent. 2011;23(4):219-36. PMID: 21806753.
8. Resnik R. Misch's Contemproray Implant Dentistry. 4th ed. St. Louis: Elsevier; 2021. p.1-1241.
9. Uhlendorf Y, Sartori IA, Melo AC, Uhlendorf J. Changes in lip profile of edentulous patients after placement of maxillary implant-supported fixed prosthesis: is a wax try-in a reliable diagnostic tool? Int J Oral Maxillofac Implants. 2017;32(3):593-7. PMID: 27706267.
10. Ercoli C, Graser GN, Tallents RH, Galindo D. Face-bow record without a third point of reference: theoretical considerations and an alternative technique. J Prosthet Dent. 1999;82(2):237-41. PMID: 10424992.
11. Çavdar Yılmaz NP, Bay C, Yılmaz İN, Kelsaka O, Ok FN, Ateş A, et al. Unlocking nasal angle anthropometry and nasolabial angle preferences: a key to achieve the perfect rhinoplasty. Anatomy. 2023;17(2):70-81. doi:10.2399/ana.23.1393798
12. Enlow DH, Hans MG. Essentials of facial growth. 2nd ed. Massachusetts: Needham Press; 2008. p.507.
13. Tallgren A. The continuing reduction of the residual alveolar ridges in complete denture wearers: a mixed-longitudinal study covering 25 years. J Prosthet Dent. 1972;27(2):120-32. PMID: 4500507.
14. Palac A, Bitanga P, Capkun V, Kovacic I. Association of cephalometric changes after 5 years of complete dentures wearing and oral health-related quality-of-life. Acta Odontol Scand. 2013;71(3-4):449-56. PMID: 22747438.
15. Cheng C, Cheng X, Dai N, Tang T, Xu Z, Cai J. Facial morphology prediction after complete denture restoration based on principal component analysis. J Oral Biol Craniofac Res. 2019;9(3):241-50. PMID: 31205850; PMCID: PMC6558308.
16. Suzuki A, Suzuki T, Hayakawa I. Influence of occlusal vertical dimension and labiolingual position of artificial anterior teeth in complete dentures on the facial appearance. Prosthodontic Research&Practice. 2006;5(1):44-51. https://www.jstage.jst.go.jp/article/prp/5/1/5_1_44/_pdf
17. Besford JN, Sutton AF. Aesthetic possibilities in removable prosthodontics. Part 2: start with the face not the teeth when rehearsing lip support and tooth positions. Br Dent J. 2018;224(3):141-8. PMID: 29422560.
18. Ellis JS, Pelekis ND, Thomason JM. Conventional rehabilitation of edentulous patients: the impact on oral health-related quality of life and patient satisfaction. J Prosthodont. 2007;16(1):37-42. PMID: 17244306.
19. Jeffcoat MK. Bone loss in the oral cavity. J Bone Miner Res. 1993;8 Suppl 2:S467-73. PMID: 8122514.
20. Joda T, Gallucci GO. The virtual patient in dental medicine. Clin Oral Implants Res. 2015;26(6):725-6. PMID: 24665872.
21. Revilla-León M, Gómez-Polo M, Vyas S, Barmak AB, Gallucci GO, Att W, et al. Artificial intelligence models for tooth-supported fixed and removable prosthodontics: a systematic review. J Prosthet Dent. 2023;129(2):276-92. PMID: 34281697.