Research Article

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Comparative Cephalometric Evaluation of Facial Profiles with Stable Land Marks Versus Steiner's Analysis: A Short Study

Ambati Sai Krishna[1*] D.R.V. Kumar[2] Nirupama Naidu[3] K. Vijaykanth[4] Viswa Chaitanya Chandu[5]

[1]Department of Prosthodontics, Anil Neerukonda Institute of Dental Sciences, Visakhapatnam, India.
[2]Department of Prosthodontics, Anil Neerukonda Institute of Dental Sciences, Visakhapatnam, India.
[3]Department of Prosthodontics, Anil Neerukonda Institute of Dental Sciences, Visakhapatnam, India.
[4]Department of Prosthodontics, Anil Neerukonda Institute of Dental Sciences, Visakhapatnam, India.
[5]Department of Public Health Dentistry, Government Dental College & Hospital, Vijayawada, India.

ABSTRACT

Background: Face is the index of mind, facial profile is considered to be as an important diagnostic tool in the diagnosis and treatment planning of complete denture rehabilitation. The distance between the mental foramen and the genion is also measured and based on the distance between these 2 stable structures the profiles can be classified for the complete rehabilitation.

Materials and method: 90 anonymized lateral cephalograms of dentate subjects, comprising of 3 equal groups of Angle's Class I, II and III, were taken for this retrospective study from the archives of the Department of Orthodontics, Anil Neerukonda Institute of Dental Sciences, Sangivalasa, Vishakhapatnam. The stress axis line was marked on the lateral cephalograms followed by the tangent from Centro masticale i.e., crista galli to the inner aspect of the chin i.e., genion. Another line was drawn from crista galli to mental foramen. The angle between these 2 lines was measured. The distance between mental foramen and genion was measured as well. The values obtained were compared with Steiner's values and the correlation of profile analysis by both methods was statistically assessed using Pearson's Correlation

Results: Statistical analysis by way of Pearson's Correlation revealed no significant co relation was formed between ANB angle and crista galli- mental foramen genion among subjects with class I and class III (p value of class I and class III were 0.566 and 0.681) and p value for class II of stable landmarks was 0.04 which had significant co-relation with ANB values of class II.

Conclusion: we can conclude that there is a significant variation and ease of differentiation between the class II profiles.

Keywords: Cephalometric Evaluation, facial profile, orthodontics.

INTRODUCTION

The profession encountered little contribution from the literature regarding facial profiles. Accordingly, few methods have been discovered in order to evaluate the facial profile. Improving the appearance of facial aesthetics is the part and parcel of all the disciplines in the dentistry, though orthodontics considered it early in the history. The term aesthetics has been mentioned and introduced to dentistry by Alexander Baumgarten treaty "reflections on poetry" in 1753[1]. The traditional aesthetics has been assessed by comparing with the harmony and balanced features of "apollobelvader"[1]. The modern / European aesthetics depends on the art works of the influenced scholars and their thinking thought. It is not applied universally and emphasizes that each

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***Correspondence Dr. Ambati Sai Krishna.**
1Department of Prosthodontics, Anil Neerukonda Institute of Dental Sciences, Visakhapatnam, India.
Email: Not Disclosed

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style of art had to be evaluated independently, where the subjective response of the observer is highly considered. Angle was the 1st of the many orthodontists who considered traditional concepts and standard treatment formulas to enhance facial appearance. The aesthetics of the face can be enhanced by using two views: -The lateral and the anterior-posterior views.

The lateral view is commonly referred to as profile, in strict sense it applies to outline of the face in lateral view (pro -before, filum – thread).[1] The profile is the easiest view of the face to draw which helps to evaluate the orientation of anterior teeth and also changes due to growth. So better evaluation of growth changes is made easy with the help of radiographs. The lateral radiographs depict soft tissues outline and underlying dento skeletal structures. Steiner in his analysis to evaluate the profile[2] considered Sella turcica, Nasion, point A and point B. But, Point A and Point B may vary in dentulous and edentulous conditions of the same person. Hence, Steiner's analysis cannot be used to access profile in edentulous patients. Peter Bhemler in his work stated that, when curve of Spee is extended to a circle, the centre of the circle is the crista galli or Centro masticale[3]. The connecting line between the Centro-masticale and mentale is called the stress axis. Based on the angle between the stress axis and reference points, the profiles can be classified into class I, class II and class III. The present study considered mental foramen as one of the reference points to the stress axis line to classify profiles.

MATERIALS AND METHODS

Young adult dentate subjects (n=90) with ages ranging from 25 to 30 years are selected. These subjects are selected and categorized by observing facial profiles and divided into 3 groups. Group I as class I profile, group II as class II facial profile and group III as class III profile. Lateral cephalograms and posterior anterior views are obtained for all the subjects. Cephalometric tracings for Steiner analysis are obtained for all the lateral cephalograms and compared the facial profiles with that of profiles categorized clinically. Subjects that do not match with the cephalometric tracings are excluded ensuring 30 subjects for each group. On all the cephalometric tracings of lateral cephalograms, a vertical line is drawn from the highest point of crista galli to the center of mental foramen in the mandible. Similarly, another vertical line is marked from crista galli to the inner point in the mentum which is referred to as genion or mentale. A line from crista galli to Sella turcica is marked and this line is considered as the angle between the 2 vertical lines from crista galli to mental foramen and genion. Similarly, the distance between these 2 lines is measured near the mental foramen area. The protractor is placed on the tracing sheet such that the base line of the protractor coincides with the line passing from crista galli to Sella turcica (Figure 1, Figure 2). The angle formed between the two vertical lines is measured and the distance between these 2 lines from mental foramen to genion is measured for all the subjects in each group. The values are tabulated and statistically evaluated, and the results are interpreted. The basic principle involved in this methodology is based on Steiner analysis to classify facial profiles. The curve of Spee is the hypothetical center to the masticatory forces within the stomatognathic system. When the curve of spee is extended to a circle, the center is found at the crista galli or centero masticale. The longitudinal axes of the upper first premolars i.e., apicale frequently coincided with the radius. This also holds true for the lower premolars. These premolars were in the theoretically perfect position to absorb the pressure of the mastication. For this reason, the connecting line between the Centro masticale and mentale was called stress axis. It can be used as indicator for existing co relation with in the stomatognathic system. Interpretation of crista galli is best evaluated in posterior anteriorly, however from a prosthodontic perspective lateral cephalogram are most commonly interpreted. An attempt is made to identify crista galli from lateral cephalograms. While interpreting the lateral cephalogram measuring the distance between mental foramen and genion, arbitrarily ensures identifying the profile of patients rather than measuring the angles. Clinically when patient profile cannot be clearly defined (edentulous condition) the stress axis can be applied to reveal the hidden developmental tendencies.

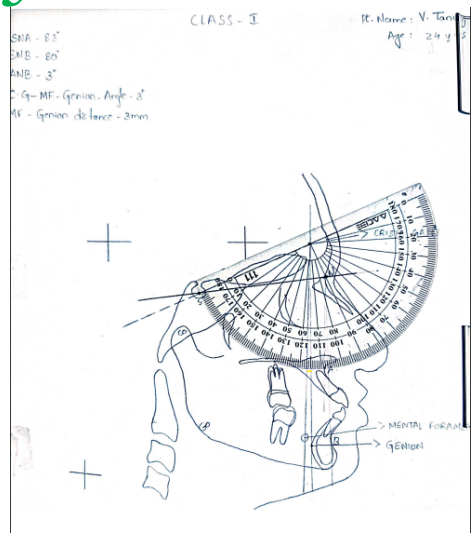

Fig 1: The protractor is placed on the tracing sheet such that the base line of the protractor coincides with the line passing from crista galli to Sella turcica.

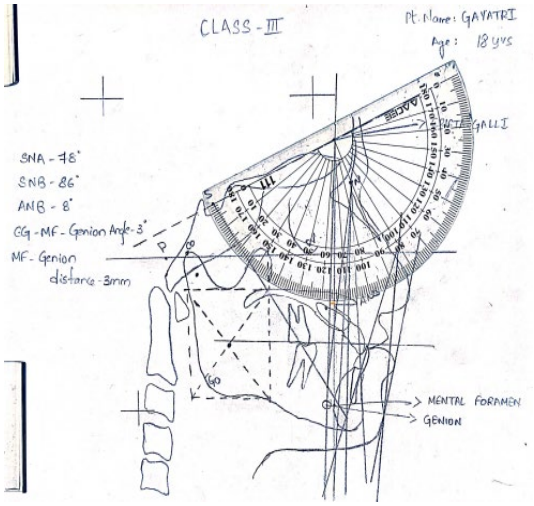

Fig 2: The protractor is placed on the tracing sheet such that the base line of the protractor coincides with the line passing from crista galli to Sella turcica for class III.

Statistical analysis:

Statistical analysis was performed using SPSS version 20 software (IBM SPSS statistics for Windows version 20, Armonk, NY, USA). Descriptive statistics, one-way analyses of variance with Tukey's post hoc tests were done to analyze the study data. Pearson's Correlation was also analyzed.

RESULTS

Based on an analysis of the data tabulated in Microsoft Excel and subjected to statistical analysis the following inferences were drawn:

Pearson's Correlation revealed no significant co relation between Steiner's ANB angle and the Crista galli- Mental foramen Genion angle among subjects with Angle's class I and class III (p value of class I and class III were 0.566 and 0.681) and p value for Angle's class II of stable landmarks was 0.04 which had significant co-relation with ANB values of Angle's class II.

- Significant differences were noted between subjects with different malocclusion classes in the SNA, SNB, and ANB angles (Table 1, Table 2, Figure 3, Figure 4).
- In Tukey's post Hoc analysis, it was observed that all pairwise comparisons were statistically significant except the SNA angle between subjects with class 1 and class 2 malocclusion. SNB and ANB values were significantly higher among subjects with class 3 malocclusion.
- Significant differences were noted between groups in the angle between lines drawn from crista galli - mental foramen and mental foramen –genion with highest values recorded among subjects with class 2 malocclusion. In the post Hoc analysis, no significant difference was noted between Classes 1 and 2 (Table 3, Table 4).
- Significant differences were noted between groups in the distance between mental foramen and genion with highest values recorded among subjects with class 2 malocclusion. In the post Hoc analysis, no significant difference was noted between Classes 1 and 2 (Figure 5).

Table 1: Comparison of metrics from Steiner's analysis based on malocclusion class

Parameter	Class	N	Mean	Std. Deviation	95% Confidence Interval for Mean		F value	P value
					Lower Bound	Upper Bound		
SNA	1	30	82.00	2.213	81.17	82.83	59.094	<0.001*
	2	30	82.00	2.213	81.17	82.83		
	3	30	76.00	2.913	74.91	77.09		
SNB	1	30	79.93	1.856	79.24	80.63	37.124	<0.001*
	2	30	77.10	2.040	76.34	77.86		
	3	30	82.07	2.728	81.05	83.09		
ANB	1	30	2.07	.944	1.71	2.42	74.38	<0.001*
	2	30	4.93	1.112	4.52	5.35		
	3	30	6.13	1.776	5.47	6.80		

One way analysis of variance; p≤0.05 considered statistically significant; * denotes statistical significance

Table 2: Multiple pairwise comparisons of metrics from Steiner's analysis based on malocclusion class

Parameter	Reference Class	Comparison Class	Mean Difference (I-J)	P value	95% Confidence Interval	
					Lower Bound	Upper Bound
SNA	1	2	.000	1.000	-1.52	1.52
		3	6.000*	<.001*	4.48	7.52
	2	3	6.000*	<.001*	4.48	7.52
SNB	1	2	2.833*	<.001*	1.45	4.21
		3	-2.133*	.001*	-3.51	-.75
	2	3	-4.967*	<.001*	-6.35	-3.59
ANB	1	2	-2.867*	<.001*	-3.68	-2.05
		3	-4.067*	<.001*	-4.88	-3.25
	2	3	-1.200*	.002*	-2.02	-.38

Tukey's post hoc tests for multiple pairwise comparisons; p≤0.05 considered statistically significant; * denotes statistical significance

Table 3: Comparison of the angle and distances between landmarks based on malocclusion class

Parameter	Class	N	Mean	Std. Deviation	95% Confidence Interval for Mean		F value	P value
					Lower Bound	Lower Bound		
Crista galli - mental foramen -genion	1	30	3.43	1.382	2.92	3.95	18.38	<0.001*
	2	30	3.73	.944	3.38	4.09		
	3	30	2.13	.860	1.81	2.45		
Mental foramen - genion	1	30	5.033	2.0924	4.252	5.815	16.19	<0.001*
	2	30	5.883	1.3370	5.384	6.383		
	3	30	3.467	1.4794	2.914	4.019		

One way analysis of variance; p≤0.05 considered statistically significant; * denotes statistical significance

Table 4: Multiple pairwise comparisons of the angle and distances between landmarks based on malocclusion class

Parameter	Reference Class	Comparison Class	Mean Difference (I-J)	P value	95% Confidence Interval	
					Lower Bound	Upper Bound
Crista galli - mental foramen -genion	1	2	-.300	.536	-.97	.37
		3	1.300	<.001*	.63	1.97
	2	3	1.600	<.001*	.93	2.27
Mental foramen - genion	1	2	-.8500	.125	-1.877	.177
		3	1.566	.001*	.539	2.594
	2	3	2.4167	<.001*	1.389	3.444

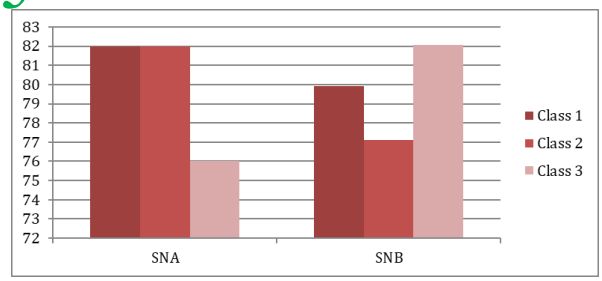

Fig 3: Comparison of metrics from Steiner's analysis based on malocclusion class.

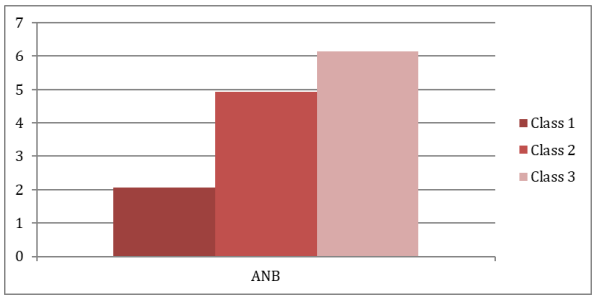

Fig 4: Comparison of metrics from Steiner's analysis based on malocclusion class.

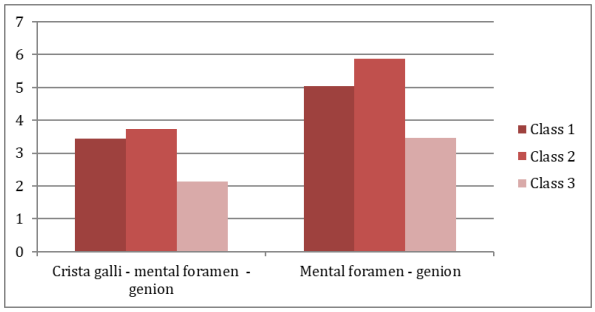

Fig 5: Comparison of the distances between landmarks based on malocclusion class

DISCUSSION

The problem of edentulism or the total absence of one's teeth has plagued mankind for centuries. Management of this condition up until the last 100 years has had limited success. The Etruscans gave us the first known attempts at tooth replacement by fabricating metal frameworks in which human or animal teeth were inserted around 700 BC[4]. Wood was used by the Japanese in the early 16th century using softened beeswax for the impressions and then meticulously carving the wood to match the impression. In 1770, Alex Duchateau made the first porcelain dentures, which was the beginning of replacement teeth that were more durable and meant for function as well as appearance. Around 1850, vulcanite became the material of choice for dentures[5]. It was a hard compound derived from rubber and it could be formed on models with porcelain teeth embedded in it to make it a reasonable dentition replacement exhibiting the first real attempt at form, fit, and function. The 20th century brought us acrylics and plastics, which are the standard of today. Although there has been a long history of advancement in denture materials, the fact remains that the way these prostheses are made is by hand. The labor-intensive requirements of hand setting the teeth, and preparing the prosthesis for fabrication is still the norm today, as it was centuries ago.

The explosion of technology in dentistry has shown that up to 60% of crown-and-bridge work is currently being done using a digital workflow by laboratories and CAD/CAM has allowed them to do far more using less manpower[6]. With more than 31% of all adults over the age of 65 being edentulous today, and that number growing each year because of our aging population, the struggle to provide dental care for a growing edentulous population is increasing[7] and dental labs will need to adjust accordingly. Many labs today are already experiencing a technician shortage along with an aging population of talented workers with the wisdom of years in designing dentures[8]. Analog denture fabrication may not be able to keep up with the future demand.

This handcrafted, time-consuming approach to denture making has recently been challenged by the utilization of CAD/CAM and 3D printing[9]. Along with the creation and development of software to establish the placement of teeth in a virtual environment, the new workflow represents an enormous step forward in the century old methods of denture making[10]. Profile assessment plays a vital role in giving a harmonious occlusion while reconstructing completely edentulous conditions. Steiner's analysis is a reliable one to access profiles for dentate individuals. This analysis uses certain soft tissue landmarks like Point A and Point B to access the profile. These soft tissue landmarks are prone to change after the loss of teeth. Hence, Steiner's analysis cannot be used to access profiles in edentulous patients. Thus, there is always a room for an analysis which relays on stable hard tissue landmarks to access the profile in edentulous patients. Also, these landmarks should be easily identifiable in routine radiographic investigations

during digitally reconstructing the occlusal plane like lateral cephalograms and CBCTs. This study uses such land marks and they are: Crista Galli, Mental foramen and Genion.

It is a well-known fact that, Curve of Spee is a reliable finding for a harmonious occlusion. Peter Bhemler, in his study stated that, when the Curve of Spee is extended to an imaginary circle, its center lies in Crista Galli or Centero Masticale. The radius from the Centro Masticale is exactly coinciding with the longitudinal axis of upper first premolar and sometimes lower first premolars as well. This radius when extending down is connecting with the Genion[3]. Thus, in the study he concluded that, the line joining the Centro Masticale with the Genion is called as the stress axis and premolars are the reliable load bearing areas. Hence, the landmarks of the stress axis in relation to the stable reference point, the mental foramen are considered to access the profiles of edentulous patients.

In the present study, the Steiner's Class I, Class II and Class III profile patients are studied in order to draw a correlation between Steiner's land marks and the stable land marks (Crista Galli, Mental Foramen and Genion) such that, these stable land marks can be used to access profile of edentulous patients. The ANB angle of Class I Steiner's analysis is between 2-4^0 (Figure 6). The angle between the lines connecting Crista Galli - Mental foramen and Crista Galli - Genion for Class I patients is also between 2-4^0 coinciding with the Steiner's Class I analysis. Similarly, the Class II Steiner's analysis also coincided with the profile analysis of stable land marks used in this study (5-8^0) (Figure 7). For Class III profiles, the Steiner's analysis values are between -2 to -4 ^{0}and the values are between 2 to 4^0 in stable landmarks (Figure 8). So, according to these results, there was no reliable correlation between Class I and Class III analysis using stable landmarks. The distance between the mental foramen and genion is around 4.7 mm in class I, 5.5mm in class II, and in class III it is around 4.2 mm. Thus, there is no big difference in the average values of the distance between mental foramen and genion. There is no possibility to differentiate between the profiles. Furthermore, scope of investigation is required to access and differentiate Class I and Class III profile patients.

However, this study can clearly insist on one particular point and that is, irrespective of the type of profile, identifying the stress axis in the radiographs and aligning the long axis of premolars parallel to the stress axis in digital workflow gives us a harmonious occlusion.

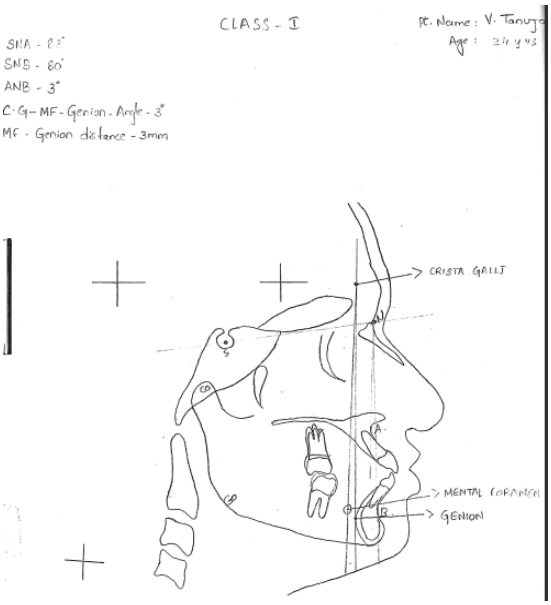

Fig :6 Class I.

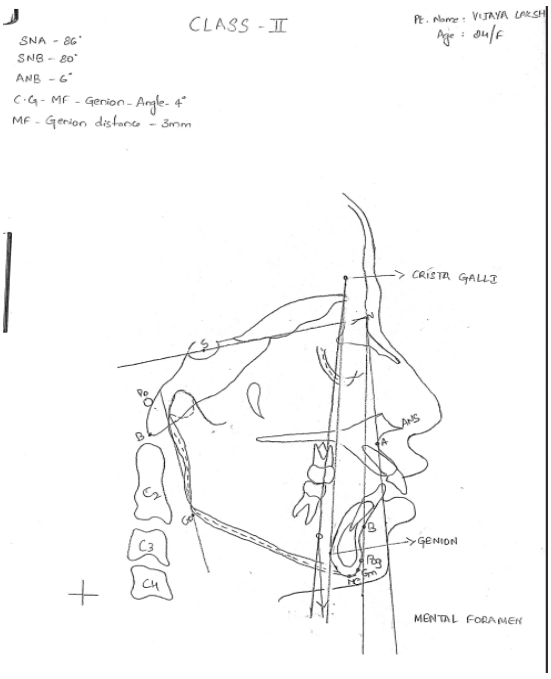

Fig 7: Class II.

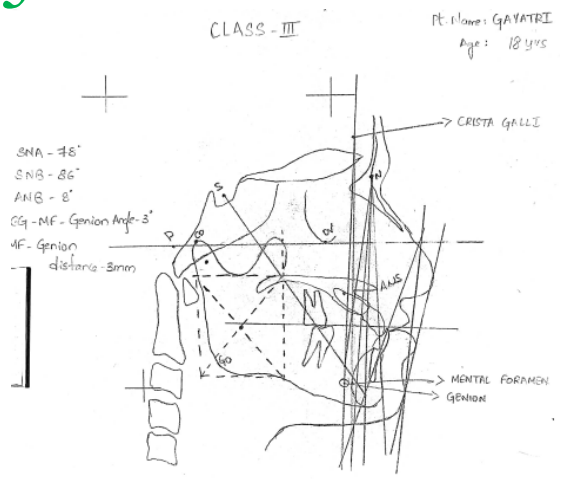

Fig 8: Class III.

CONCLUSION

Determination of profile is of great importance to achieve harmonious occlusion and esthetics during rehabilitation of completely edentulous patients. This can be achieved by analyzing and attaining a correlation between stable landmarks. An attempt has been made in this study to derive the same but further deep investigation and study has to be done to draw any conclusions.

REFERENCES

1. Powell SJ, Rayson RK. The profile in facial aesthetics. Br J Orthod. 1976 Oct;3(4):207-15.
2. Steiner, C.C. (1953) Cephalometrics for You and Me. American Journal of Orthodontics, 39, 729-755.
3. Bhimler, H.P. & Bhimler, B. (2012). Studies on the "curve of spee". Journal of Stomatology. 65. 83-96.
4. Edentulous: A Brief History of Dentures. Accessed December 22, 2016.
5. British Dental Association. Teeth and dentures. Accessed December 22, 2016.
6. Molinaro K. Digital Trends You Need to Know. NADL Materials and Equipment survey. 2014. Accessed january 3, 2017. 2015.
7. Vargas CM, Kramarow EA, Yellowitz JA. The Oral Health of Older Americans. Trends in Health and Aging. Accessed January 12, 2017.
8. Schweiger J, Güth JF, Edelhoff D, Stumbaum J. Virtual evaluation for CAD-CAM-fabricated complete dentures. J Prosthet Dent. 2016 Aug 1.
9. Battersby J. CAD/CAM – The end for dental labs or a new beginning? 2014. Accessed January 3, 2017.
10. David A. Burt. Digital Dentures. Inside Dentistry.2017 Feb;13(2).