

Evaluation of the Modified True Vertical Line in Unilateral Complete Cleft Lip and Palate Patients

Tek Taraflı Dudak Damak Yarıklı Bireylerde Modifiye Gerçek Dikey Çizginin Konumunun Değerlendirilmesi

İşıl ARAS,^a
Ayşe Burcu ALTAN,^b
Servet DOĞAN,^a
Enver YETKİNER^a

^aDepartment of Orthodontics,
Ege University Faculty of Dentistry,
İzmir

^bDepartment of Orthodontics,
Kocaeli University Faculty of Dentistry,
Kocaeli

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Yazışma Adresi/Correspondence:
İşıl ARAS

Ege University Faculty of Dentistry,
Department of Orthodontics, İzmir
TÜRKİYE/TURKEY
isilaras@gmail.com

ABSTRACT Objective: To compare the facial anteroposterior projection parameters of unilateral complete cleft lip and palate (UCCLP) patients with non-cleft (NC) individuals having well-balanced faces using Arnett and Gunson Module and determine the capability of modified true vertical line (mTVL) to depict the true extent of retrognathism in UCCLP patients was aimed. **Material and Methods:** Arnett and Gunson Analysis was used in the evaluation of standard cephalometric headfilms of 30 UCCLP individuals and 30 NC patients with pleasing facial profile between the ages of 17-19 years, taken in natural head position. Projection values relative to true vertical line (TVL, in NC individuals) or modified true vertical line (mTVL, in UCCLP) were measured. Second measurements were done relative to a line that is parallel to the TVL/mTVL but passing through the geometric center of sella turcica (sTVL). Independent samples t-test was used to compare the projections values of the groups. **Results:** Significantly greater projection values were acquired for Gb, Or, CB, SP, NB, A, Mx1, Md1, LLA, Pog' ($p \leq 0.0001$), B' ($p \leq 0.001$) and NT ($p \leq 0.05$) distances in UCCLP patients (using mTVL) compared to NC individuals (using TVL). On the other hand, projection values of Or, SP, NT, Mx1, ULA ($p \leq 0.0001$), A ($p \leq 0.001$), NB, A' ($p \leq 0.001$) and Gb, CB, Md1, LLA ($p \leq 0.05$) showed significant inadequacies in UCCLP patients when measurements were carried out relative to sTVL. **Conclusion:** This preliminary study showed that mTVL obtained by carrying the subnasale point 3 mm forward was still deficient in varying amounts depending on the severity of the midfacial retrognathism.

Key Words: Cleft lip; cleft palate; cephalometry

ÖZET Amaç: Tek taraflı komple dudak ve damak yarıklı (UCCLP) hastalarda ve estetik dengeye sahip yarıksız (NC) bireylerde Arnett ve Gunson Modülü kullanılarak yüzün anteroposterior projeksiyon değerlerinin karşılaştırılması ve modifiye gerçek dikey çizginin (mTVL) UCCLP hastalarda retrognatizmin gerçek boyutunu gösterebilme yeterliliğinin belirlenmesi amaçlanmıştır. **Gereç ve Yöntemler:** Yaşları 17-19 yıl arası değişen 30 UCCLP bireyin ve 30 NC hastanın, doğal baş postüründe alınmış standardize sefalometrik filmlerinin değerlendirilmesinde Arnett ve Gunson Analizi kullanıldı. Gerçek dikey çizgiye (TVL, NC bireylerde) ya da modifiye gerçek dikey çizgiye (mTVL, UCCLP hastalarda) göre projeksiyon değerleri ölçüldü. İkinci ölçümler, TVL (NC bireylerde) ya da mTVL'ye (UCCLP bireylerde) paralel fakat sella tursika'nın geometrik merkezinden geçen dikey çizgiye (sTVL) göre yapıldı. Gruplar arası projeksiyon değerlerinin karşılaştırılmasında bağımsız t-testi kullanıldı. **Bulgular:** UCCLP hastalarda ölçülen (mTVL kullanılarak) Gb, Or, CB, SP, NB, A, Mx1, Md1, LLA, Pog' ($p \leq 0.0001$), B ($p \leq 0.001$) ve NT ($p \leq 0.05$) noktalarının projeksiyon değerleri NC bireylerde ölçülen (TVL kullanılarak) projeksiyon değerlerine göre önemli derecede ileride çıktı. Diğer taraftan, aynı ölçümler sTVL göre yapıldığında Or, SP, NT, Mx1, ULA ($p \leq 0.0001$), A ($p \leq 0.001$); NB, A' ($p \leq 0.001$) ve Gb, CB, Md1, LLA ($p \leq 0.05$) noktalarının projeksiyon değerleri UCCLP bireylerde istatistiksel olarak önemli yetersizlikler gösterdi. **Sonuç:** Bu ön çalışma, subnazal noktanın 3 mm öne taşınması ile elde edilen mTVL'nin, orta yüzün retrognatizminin gerçek boyutunu göstermede hala değişen oranlarda yetersiz olduğunu gösterdi.

Anahtar Kelimeler: Yarık dudak; yarık damak; sefalometri

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Treatment planning depending on conventional cephalometric methods cannot always provide ideal esthetic results.^{1,2} Pioneering factors influencing the esthetic aspects of treatment outcomes and stability are neither the hard tissue spatial relations nor the dental occlusion, but soft tissue determinants. However, soft tissue determinants and soft tissue coverage can vary greatly due to thickness, length and postural tone of its own constitution so that the underlying anomaly can totally be masked or perfect hard tissue composition may present itself inadequate in terms of esthetics.^{2,3} Thus, Arnett and Gunson's module based on soft tissue paradigm is used today instead of conventional cephalometric appraisals.⁴ This soft tissue paradigm has deemed essential that the anatomical landmarks be evaluated relative to true vertical line (TVL).⁵ To pinpoint the correct position of TVL, it is recommended to record cephalometric radiographs with the head in natural head position (NHP), and then the TVL be located through subnasale and perpendicular to the floor after which the facial projections will be measured relative to this fiducial line.⁵

In cases of midfacial retrusion, it has been recommended to move the TVL 1-3 mm anteriorly.⁶ However cleft patients usually present with serious midfacial deficiencies. Therefore, it is doubted whether the TVL carried 3 mm forward would be sufficient to depict the true magnitude of the deficiency to form a precise treatment plan. Said that, no study has investigated the sufficiency of mTVL up till now. When considered that these individuals contend many adjunct health problems, multiple surgeries, and are presenting with psychological problems due to facial esthetics, it is the utmost importance to provide them with the ideal treatment modality, which is only possible with the correct diagnosis method.⁷⁻⁹

Hence the purpose of this preliminary study is to determine if TVL carried 3 mm anterior to the subnasale point is capable of providing the actual extent of the maxillary retrognathism in unilateral complete cleft lip and palate patients (UCCLP), when compared to the non-cleft (NC) controls presenting with a pleasing facial profile.

MATERIAL AND METHODS

The study protocol was approved (no: 15-9.1/12) by the Ethics Committee of the School of Medicine, Ege University.

The cephalometric films of 30 UCCLP individuals and 30 patients without cleft having a pleasing facial profile between the ages of 17-19 years were selected from the archives of Orthodontics Departments of Ege University and Kocaeli University, respectively. The mean ages were 17.67 and 17.40 years, in UCCLP and NC subjects, respectively, with each group having 15 male and 15 female subjects. In both groups it was paid attention that patients with syndromes or systemic diseases were not included. Also, no orthodontic treatment was received prior to acquisition of cephalometric films but cleft lip and palate subjects had undergone their primary surgeries. Inclusion of NC individuals was based on extraoral photographic evaluation of the patients presenting with competent midface and lower jaw region considering the cheek, nose, malar, upper and lower lip areas while vice versa was true for the maxillary region in UCCLP patients. Special care was taken that films were attained with the patients in natural head position. The images were acquired at 73 kVp, 10 mA for 17,0 sec of exposure. Measurements were carried out by investigators (A.B.A. and S.D.) using Dolphin Image Software, Version 11.0 (Dolphin Imaging and Management Solutions, Los Angeles, California, USA). While original TVL was used in the NC individuals, modified TVL (mTVL) that was carried 3 mm anterior to subnasale point was used in UCCLP patients. Projection values were measured relative to these lines. At the second stage, a line that is parallel to the TVL (in NC individuals) or mTVL (in UCCLP individuals), but passing through the geometric center of sella turcica (sTVL) was constructed in both groups followed by the measurement of the same projection values, this time relative to sTVL (Figure 1). The conformity among these two sets of measurements was assessed by statistical analysis. The adequacy of mTVL was questioned based on

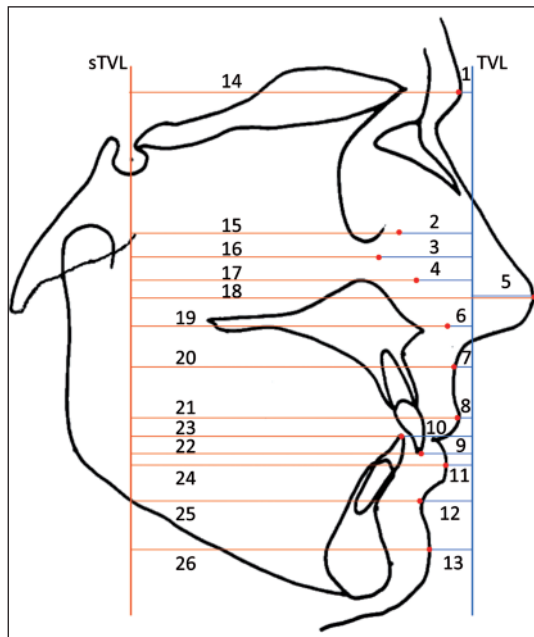


FIGURE 1: Projection values measured with respect to TVL and sTVL.

TVL: A line placed through subnasale and was perpendicular to the natural horizontal head position; sTVL: A line constructed parallel to the TVL/mTVL but passing through the geometric center of sella turcica; (1) TVL-Gb': Soft Tissue Glabellar Projection, horizontal distance from TVL to soft tissue glabella (2) TVL-Or': Soft Tissue Orbital Rim Projection, horizontal distance from TVL to soft tissue orbital rim (3) TVL-CB': Soft Tissue Cheek Bone Projection, horizontal distance from TVL to soft cheek bone (4) TVL-SP': Soft Tissue Subpupil Projection, horizontal distance from TVL to soft tissue subpupil (5) TVL-NT: Nasal Projection, horizontal distance from TVL to tip of the nose (6) TVL-NB': Soft Tissue Nasal Base Projection, horizontal distance from TVL to soft tissue nasal base (7) TVL-A': Soft Tissue A Point Projection, horizontal distance from TVL to soft tissue A point (8) TVL-ULA: Upper Lip Projection, horizontal distance from TVL to most anterior point of the upper lip (9) TVL-Mx1: Upper Incisor Tip Projection, horizontal distance from TVL to upper incisor tip (10) TVL-Md1: Lower Incisor Tip Projection, horizontal distance from TVL to lower incisor tip (11) TVL-LLA: Lower Lip Projection, horizontal distance from TVL to most anterior point of the lower lip (12) TVL-B': Soft Tissue B Point Projection, horizontal distance from TVL to soft tissue B point (13) TVL-Pog': Soft Tissue Pogonion Projection, horizontal distance from TVL to soft tissue Pogonion; (14) sTVL-Gb': Soft Tissue Glabellar Projection, horizontal distance from sTVL to soft tissue glabella (15) sTVL-Or': Soft Tissue Orbital Rim Projection, horizontal distance from sTVL to soft tissue orbital rim (16) sTVL-CB': Soft Tissue Cheek Bone Projection, horizontal distance from sTVL to soft cheek bone (17) sTVL-SP': Soft Tissue Subpupil Projection, horizontal distance from sTVL to soft tissue subpupil (18) sTVL-NT: Nasal Projection, horizontal distance from sTVL to tip of the nose (19) sTVL-NB': Soft Tissue Nasal Base Projection, horizontal distance from sTVL to soft tissue nasal base (20) sTVL-A': Soft Tissue A Point Projection, horizontal distance from sTVL to soft tissue A point (21) sTVL-ULA: Upper Lip Projection, horizontal distance from sTVL to most anterior point of the upper lip (22) sTVL-Mx1: Upper Incisor Tip Projection, horizontal distance from sTVL to upper incisor tip (23) sTVL-Md1: Lower Incisor Tip Projection, horizontal distance from sTVL to lower incisor tip (24) sTVL-LLA: Lower Lip Projection, horizontal distance from sTVL to most anterior point of the lower lip (25) sTVL-B': Soft Tissue B Point Projection, horizontal distance from sTVL to soft tissue B point (26) sTVL-Pog': Soft Tissue Pogonion Projection, horizontal distance from sTVL to soft tissue Pogonion

Table 1: Comparison of mean projection values of UCCLP and NC patients in relation of mTVL and TVL, respectively.

measurements of sTVL since the reference line was constructed at a remote and sound anatomical region unaffected from the cleft deformity. The adequacy of mTVL was based upon the whether the first set of measurements yielded similar retrusive values in clefts as acquired in second measurements with regards to sTVL.

STATISTICAL ANALYSIS

For reliability of the intra-examiner and inter-examiner assessments, intra-class correlation coefficient (ICC) were used. 10 randomly selected cephalometric roentgens were retraced in 2-weeks intervals.

Normality and homogeneity of the groups were determined by means of the Kolmogorov-Smirnov and Shapiro-Wilk tests, respectively. The significance among the distances from the landmarks to the TVL (in NC subjects) and mTVL (in UCCLP patients) and significance among the distances from the landmarks to the sTVL in the two groups were determined with independent samples t-test.

RESULTS

ICC for intra-examiner assessments were excellent with values ranging between 0.912-974, while the ICC for inter-examiner evaluations were excellent for 12 of the 13 investigated variables with only cheekbone projection scoring 0.853 which can be deemed as good.

Statistical comparisons of projection values in reference to TVL and mTVL were carried out using independent samples t-test (Table I). Significantly greater projection values were measured for Gb', Or', CB, SP, NB, A', Mx1, Md1, LLA, Pog' ($p \leq 0.0001$), B' ($p \leq 0.001$) and NT ($p \leq 0.05$) distances in UCCLP patients.

Intergroup comparisons pertaining to projection values in reference to sTVL revealed significant differences (Table 2). Or', SP, NT, Mx1, ULA ($p \leq 0.0001$), A' ($p \leq 0.001$); NB, A' ($p \leq 0.001$) and Gb', CB, Md1, LLA ($p \leq 0.05$) projection values showed significantly retrusive values in UCCLP subjects.

TABLE 1: Comparison of mean projection values of UCCLP and NC patients in relation of mTVL and TVL, respectively.

Parameters	Mean	Std. deviation	Std. error mean	p value
Gb' Projection (mm)				0.000****
Norm	-8.5	2.4		
UCCLP	8.42	0.09	0.03	
NC	-8.10	2.97	0.94	
Or' Projection (mm)				0.000****
Norm	-18.7	2.0		
UCCLP	18.57	2.59	0.82	
NC	-15.23	11.84	3.75	
CB Projection (mm)				0.000****
Norm	-25.2	4.0		
UCCLP	19.12	4.14	1.31	
NC	-34.65	2.61	0.83	
SP Projection (mm)				0.000****
Norm	-14.8	2.1		
UCCLP	16.19	3.09	0.98	
NC	-16.55	2.01	0.63	
NT Projection (mm)				0.013*
Norm	16.0	1.4		
UCCLP	16.71	2.87	0.91	
NC	15.84	2.17	0.69	
NB Projection (mm)				0.000****
Norm	-12.9	1.1		
UCCLP	11.17	3.20	1.01	
NC	-11.05	0.86	0.27	
A' Projection (mm)				0.000****
Norm	-0.3	1.0		
UCCLP	1.52	0.88	0.28	
NC	-1.13	1.03	0.33	
Mx1 Projection (mm)				0.000****
Norm	-9.2	2.2		
UCCLP	11.03	1.87	0.59	
NC	-9.35	2.00	0.63	
ULA Projection (mm)				0.699
Norm	3.7	1.2		
UCCLP	2.57	2.57	0.81	
NC	2.15	2.20	0.70	
Md1 Projection (mm)				0.000****
Norm	-12.4	2.2		
UCCLP	8.23	3.25	1.03	
NC	-11.60	1.70	0.54	
LLA Projection (mm)				0.000****
Norm	1.9	1.4		
UCCLP	4.30	1.87	0.59	
NC	0.85	2.10	0.66	
B' Projection (mm)				0.001***
Norm	-5.3	1.5		
UCCLP	3.52	2.13	0.67	
NC	-6.72	2.39	0.76	
Pog' Projection (mm)				0.000****
Norm	-2.6	1.9		
UCCLP	4.05	4.29	1.36	
NC	-3.95	3.62	1.14	

* p=0.05, ** p=0.001, ****p=0.0001, Std.: Standard.

TABLE 2: Comparison of mean projection values of each group with reference to sTVL.

Parameters	Mean	Std. Deviation	Std. Error Mean	P
Gb' Projection (mm)				
UCCLP	57,10	18,06	5,71	0,016*
NC	72,65	3,58	1,13	
Or' Projection (mm)				
UCCLP	51,85	5,48	1,73	0,000****
NC	61,92	3,43	1,08	
CB Projection (mm)				
UCCLP	52,10	5,34	1,69	0,018*
NC	56,10	5,00	1,58	
SP Projection (mm)				
UCCLP	53,80	5,77	1,82	0,000****
NC	64,20	3,77	1,19	
NT Projection (mm)				
UCCLP	78,60	8,13	2,57	0,000****
NC	95,65	5,09	1,61	
NB Projection (mm)				
UCCLP	59,60	6,70	2,12	0,001***
NC	69,70	4,66	1,47	
A' Projection (mm)				
UCCLP	69,00	7,13	2,26	0,001***
NC	79,62	4,39	1,39	
Mx1 Projection (mm)				
UCCLP	60,20	5,68	1,80	0,000****
NC	71,40	3,89	1,23	
ULA Projection (mm)				
UCCLP	71,00	6,63	2,10	0,000****
NC	82,90	4,68	1,48	
Md1 Projection (mm)				
UCCLP	62,80	5,63	1,78	0,010*
NC	69,15	4,17	1,32	
LLA Projection (mm)				
UCCLP	75,10	5,84	1,85	0,015*
NC	81,20	4,24	1,34	
B' Projection (mm)				
UCCLP	69,90	5,82	1,84	0,109
NC	74,03	5,10	1,34	
Pog' Projection (mm)				
UCCLP	72,80	5,69	1,80	0,114
NC	76,80	5,78	1,83	

* P=.05, *** P= 001, ****P=.0001, Std.: Standard.

DISCUSSION

Countless methods have been proposed to define the correct indication for patients who consult for esthetic, functional and life-long results. This led to development of soft tissue cephalometric analysis (STCA) in guidance for orthodontic and or-

thognathic treatment: Burstone, Fish and Epker, and most recently Arnett and Gunson.^{4,10,11} When all these analyses are considered, the rule of thumb is to identify the underlying problem, and treat it at the source if better esthetics and function is to be achieved. For cleft lip and palate patients, though there are internationally accepted and validated

scoring systems for facial growth, dental arch relationships and speech outcomes, Sharpe et al.¹² pointed out in their systematic review that there still is no agreed grading system concerning aesthetics of the cleft patients. When evaluating soft tissues, it has been recommended to carry the TVL 1-3 mm anteriorly in cases of midfacial retrusion.⁶ Yet, the subnasale region of cleft individuals are altered significantly with short maxilla, reduced maxillary height and depth, less growth of nose, maxilla and upper lip with deficient nasal morphology and asymmetries in three planes of the space as a sequel of surgical scars and tissue deficiencies with deviated anterior nasal spine.¹³⁻¹⁷ Hence this serious restraint of maxillary and nasal region could hinder the position of the TVL even it is carried 3 mm in front of the actual subnasale point. To the best of our knowledge, this preliminary study is the first investigation to look into the sufficiency of mTVL.

In the present study, when projection values according to TVL and mTVL were evaluated, all of the projection values except upper lip anterior presented significant differences ($p < 0.001$). The mean values of the projection distances were all greater in the UCCLP compared to the NC implying TVL line was positioned so retrusively relative to the facial structures that even the inadequate maxillary structures seemed as protrusive. Though there was a similar tendency for the upper lip anterior appraisal, due to the limited number of subjects, the values failed to reach a tangible significance level. This statistical outcome was due to the scar tissue formation having its toll primarily on the upper lip. Since upper lip is most severely affected from the surgeries underwent resulting in augmented tension with decreased thickness, this limits the anterior position of the upper lip even relative to retrusive TVL.

On the contrary, when the forementioned projection values were evaluated according to sTVL, all the distances showed varying degrees of statistically significant amounts of deficiency in UCCLP group compared to the controls. Relatively smaller significance values were observed pertaining to mandible except for the soft tissue B point

and Pog projection values which no difference was observed. These results are just as would be anticipated since significant deficiencies are expected in maxillary values due to the growth inhibition caused by the cleft surgeries whereas mandibular morphology is more or less preserved intact. On the other hand, there are several researches showing that mandibular structures and lower lips to be also retrognathic in cleft patients.¹⁶⁻¹⁸ As a result, either normal or retrognathic appraisals were to be expected concerning the mandibular structures which is in accordance with the current study showing slight retrusive values when evaluated according to sTVL.

When these two conditions are evaluated concurrently, it can be deduced that mTVL was still in close proximity to the deficient midfacial structures hiding the true extend of the maxillary retrognathism in cleft individuals. If formerly proposed mTVL is to be used, excessive projection values are to be observed in UCCLP patients indicating a normal maxilla with a set-back surgery for mandible. However it has also been reported that cleft patients present with constriction of space behind the tongue that contributes to posterior growth rotation of the mandible, open bite and oral breathing which will contraindicate mandibular set-back surgery not to worsen the already scarce airway space behind the mandible unless a serious prognathism is present. In a like manner, Katakura et al.¹⁹ showed that a significant narrowing of posterior airways space is to be experienced in cleft patients if mandibular setback surgery is to be applied. Therefore, acquiring the correct reference plane is of the paramount importance to guide the treatment mechanics of the cleft individuals.

Limitations: Due to the retrospective nature of the study it was not possible to standardize the surgical protocols among subjects, concerning operation timings, operator identities and surgical interventions preferred. It is possible that various surgical protocols or surgeon related parameters could have effect on the degree of incompetency of mTVL. Also, to be able to accomplish more compre-

hensive outcomes, bilateral complete cleft lip and palate individuals can be included if determination of a correct mTVL is to be achieved.

CONCLUSION

mTVL obtained by carrying the subnasale point 3 mm forward was shown to be still deficient in varying amounts depending on the severity of the midfacial retrognathism. Due to the anatomic vari-

ations of the nasomaxillary complex of the cleft lip and palate patients, a single predetermined TVL falls short in identifying the degree of retrognathism. Hence, the position of TVL needs to be individualized according to the needs of patient. Further studies with increased number of subjects are needed to identify a method that will enable the clinicians to locate a correct individual TVL in cleft lip and palate patients.

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