

RESEARCH ARTICLE

## The differences in parallelism between ala-tragus line and occlusal plane of down syndrome and normal individuals

An-Nissa Kusumadewi<sup>\*✉</sup>, Erna Kurnikasari<sup>\*\*</sup>, Rasmi Rikmasari<sup>\*\*</sup>, Willyanti Soewondo<sup>\*\*\*</sup>

<sup>\*</sup>Prosthodontics Specialty Study Program, Faculty of Dentistry, Universitas Padjajaran, Bandung, West Java, Indonesia

<sup>\*\*</sup>Department of Prosthodontic, Faculty of Dentistry, Universitas Padjajaran, Bandung, West Java, Indonesia

<sup>\*\*\*</sup>Department of Pediatric Dentistry, Faculty of Dentistry, Universitas Padjajaran, Bandung, West Java, Indonesia

<sup>\*</sup>Jl Sekeloa Selatan No 1 Bandung, West Java, Indonesia; ✉ correspondence: [annissa.kusumadewi@fkg.unpad.ac.id](mailto:annissa.kusumadewi@fkg.unpad.ac.id)

Submitted: 8<sup>th</sup> January 2019; Revised: 14<sup>th</sup> May 2019; Accepted: 25<sup>th</sup> June 2019

### ABSTRACT

People with down syndrome have a different craniofacial structure compared to normal individuals. Commonly, down syndrome patients have abnormal ear morphology with smaller size, and lower ear position compared to that of normal subjects. These patients also have smaller nose, shorter maxilla structure and facial height. Other disorders are anomalies in tooth shape, numbers and size. The ala-tragus line is one of the anatomical landmarks to determine the occlusal plane orientation. Abnormalities in the anatomical structure of people with down syndrome can affect the parallelism between the ala-tragus line and the occlusal plane. The purpose of this research was to determine the differences in parallelism between the ala-tragus line and the occlusal plane of people with down syndrome and normal individuals. The sample in this study were people with down syndrome and normal individuals. The sample was photographed using a digital camera with a fox plane attached to the oral cavity. Parallelism of the ala-tragus line and the occlusal plane was analyzed by tracing these photographs. Photo tracing was done using the Autocad 2013 software. The mean value of angle on people with down syndrome ( $5.852^\circ \pm 5.367^\circ$ ) was greater than that of normal individuals ( $2.169^\circ \pm 2.557^\circ$ ). Based on the research, it was concluded that the parallelism of the ala-tragus line to the occlusal plane in people with down syndrome was different from that in normal individuals. The ala-tragus inferior line in normal individuals was more parallel to the occlusal plane compared to that in people with down syndrome.

**Keywords:** ala-tragus line; down syndrome; occlusal plane; parallelism

### INTRODUCTION

Down syndrome is a chromosomal abnormality due to an excessive number of chromosome 21. Individuals with down syndrome have three copies of chromosome 21 (trisomy) for a total number of 47 chromosomes per cell instead of the normal two copies. Human cells normally have 23 pairs of cell chromosomes.<sup>1,2</sup> Thus, people with down syndrome generally have distinctive physical characteristics, including abnormalities in the head and facial structure with smaller skulls, anteroposterior flattened skull, slanted eyes, flat bridge-nose, smaller ears, and muscle hypotonia.<sup>1,3</sup> The nasal bone, midfacial bone, and maxilla are relatively smaller in size, which is caused by the occurrence of midfacial hypoplasia. Teeth abnormalities, such

as tooth agenesis, microdontia, malformations of teeth, smaller clinical crown than the normal tooth, smaller and conical tooth root, also occur in people with Down syndrome.<sup>4</sup>

People with down syndrome have problems in physical and intellectual abilities so that their abilities in learning and communication are limited.<sup>4,5</sup> These limitations affect their ability to maintain the oral health, so that people with down syndrome, especially the adults, have a high prevalence of periodontal disease and have an increased risk of dental caries.<sup>4</sup> The research of Shukla et al.<sup>5</sup> showed that the prevalence of caries occurred in 78% of down syndrome subjects, 33.8% of subjects experienced tooth loss, and 90% of subjects with down syndrome needed periodontal treatment. The

high prevalence of periodontal and caries diseases in people with down syndrome increases the risk of losing teeth,<sup>4,5</sup> so that denture treatment is needed.<sup>6</sup>

Determination of the occlusal plane orientation is one of the important steps in complete dentures fabrication or fabrication of partial dentures with extensive tooth loss in the maxilla. The occlusal plane has an important role in aesthetic function, phonetics, mechanical concepts of balanced occlusion, and denture stability.<sup>7</sup> The occlusal plane of the denture should be placed in accordance with the position occupied by the original tooth.<sup>7</sup> Therefore, a reference plane is needed to determine the area of occlusal plane orientation. The reference plane that is often used is the ala-tragus line or Camper's line. The ala-tragus line is a line drawn from the inferior border of the ala of the nose to a certain point in the tragus of the ear.<sup>8</sup> Determination of the exact point in the ear tragus is still controversial. Previous researchers divided the ear tragus into 3 different points, namely the superior tragus, middle tragus, and inferior tragus.<sup>9-12</sup> Nayar et al.<sup>9</sup> and Kumar et al.<sup>10</sup> reported that the occlusal plane in a normal individual is almost parallel to the line drawn from the ala of the nose to the inferior border of the tragus.

Research on the occlusal plane of people with Down syndrome has never been studied in the literature. Specific abnormalities in the structure of the head, face, ears, oral cavity, and teeth on down syndrome subjects can affect the parallelism between the occlusal plane and the ala-tragus line. On this basis, this study aims to answer the following research questions: are there any differences in parallelism between ala-tragus line and the occlusal plane of individuals with down syndrome and that in normal individuals? This this research aimed to determine the differences in parallelism between the ala-tragus line and the occlusal plane of people with down syndrome and that in normal individuals.

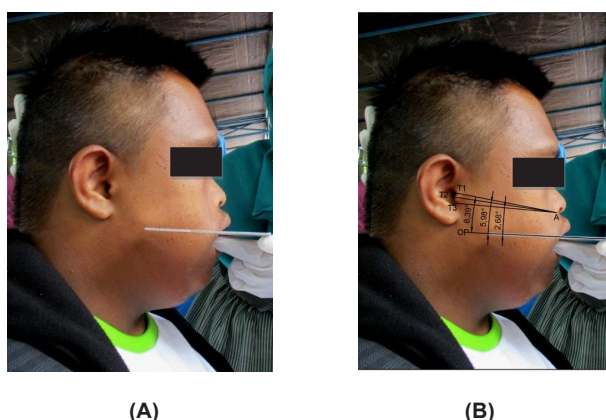
## **MATERIALS AND METHODS**

The research conducted was a cross sectional study. It was conducted at the Rumah Sakit Gigi dan Mulut (RSGM) Faculty of Dentistry, Universitas Padjadjaran in June-August 2016 and in SLB in

July-August 2016. This study was approved by the Research Ethics Committee, Faculty of Medicine UNPAD (Ethics Approval Letter No. 440 / UN6. C1.3.2 / KEPK / PN / 2016). The population in this study were people with down syndrome from POTADS (Parent Association with down syndrome Children) Bandung, SLB C YTB and SLB ABCDE-LOB Bandung. Normal individuals in this study were the students from Faculty of Dentistry UNPAD. The research sampling from the population was done by purposive sampling. The inclusion criteria for the study sample included a minimum age of 18 years for women and a minimum age of 20 years for men; People with down syndrome having at least one tooth in the anterior and two teeth posteriorly, while normal individuals should have the permanent teeth that have all erupted for 28-32 pieces; There was no persistence of deciduous teeth which can interfere with the determination of the occlusal plane; There were no extruded teeth; The incisal of the anterior teeth and the cusp of posterior teeth must be intact, with no attrition, fracture or filled; and the research samples were cooperative and willing to be the subject of research. The exclusion criteria for the sample were: Using denture either fixed or removable; having done orthodontic treatment; and having malocclusion or severe crowding which would complicate the determination of the occlusal plane.

The tools used in this study were Fox plane/ Fox bite plane (Asko, Indonesia), digital camera (Canon Digital Ixus 175; 2 0.0 MP, Japan), and tripod (Motto Excel 2830). The subjects who met the inclusion criteria were selected as the sample in this study. Subjects in normal individuals were asked to sign informed consent while subjects with down syndrome had their informed consent signed by parents/guardians. The subjects were instructed to sit on the examination chair with their back and head upright. Fox plane was positioned in the occlusal of the maxilla until the fox plane was stable in the mouth, and incisal and occlusal surfaces of the teeth touched the Fox plane. Fox plane was held in position by the operator, and the subject was photographed from the right or left side. The camera was mounted on a tripod, and the camera

height was adjusted to the position of the subject's head until the fox plane was seen as a straight line on photo. The distance between the camera and the subject's sagittal plane was one meter. The parallelism of the fox plane with the ala-tragus line was then analyzed in the photo results.<sup>9,12</sup> Tracing the photo was done using Autocad 2013 software (Autodesk, USA).<sup>9,12</sup> The line was drawn from the inferior border of the ala of the nose to the tragus point (superior, middle and inferior) then the angle of intersection between the fox plane with each ala-tragus line was measured (Figure 1). The resulted angle values were recorded for data analysis.<sup>9,12</sup> The ala-tragus line which is considered as the most parallel to the occlusal plane is the line that forms the smallest angle to the fox plane. Data analysis of this research was carried out using t-test to test the difference of two mean values in two populations.



**Figure 1.** (A) Profile picture of the subject with a mounted Fox plane, the Fox plane appears as a straight line; (B) Photograph of the subject after tracing using Autocad 2013

## RESULTS

The population of people with down syndrome amounted to 197, and of this number, 12 people met the inclusion criteria. The number, age and sex

**Table 1.** Number and sex of samples of with Down syndrome and those of normal individuals

Gender	Individuals with down syndrome		Normal Individuals	
	F	%	F	%
Women	5	41.67	6	50.00
Men	7	58.33	6	50.00
Total	12	100	12	100

of the normal individuals samples were adjusted to those of down syndrome samples (Tables 1 and 2). The intra-oral conditions of people with Down syndrome are described in Table 3.

**Table 2.** Age of samples

Age (years)	Individuals with Down syndrome		Normal Individuals	
	F	%	F	%
18-23	5	41.67	2	16.67
24-29	5	41.67	9	75.00
30-35	2	16.66	1	8.33
Total	12	100	12	100

**Table 3.** Intra-oral and ear conditions of persons with Down syndrome

Condition	F	%
Caries	4	33.33
Agensis	4	33.33
Crowding	5	41.67
Bad oral hygiene	4	33.33
Tooth shape anomalies	1	8.33
Low set ear	7	58.33

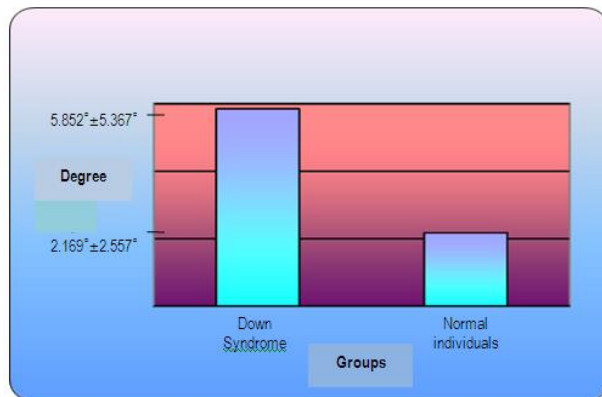
The angle value between the occlusal plane (OP) with the superior ala-tragus line (AT1), middle ala-tragus (AT2), and inferior ala-tragus (AT3) is not exactly 0°, both in normal individuals and in persons with down syndrome. Parallelism of ala-tragus line with the occlusal plane was seen from the angle value formed by the intersection of the ala-tragus line with the occlusal plane (ATx-OP). The smallest angle value was considered as the ala-tragus line which was the most parallel to the occlusal plane (Table 4). Table 5 and Figure 2 shows the mean value of the smallest angle between ala-tragus line with the occlusal plane (Angle ATX-OP) in people with down syndrome and that in normal individuals.

**Table 4.** Smallest ATx-OP Angle Value Distribution

The smallest ATx-OP angle	Individuals with down syndrome		Normal Individuals	
	F	%	F	%
T1	1	8.33	2	16.67
T2	0	0.00	2	16.67
T3	11	91.67	8	66.67
Total	12	100	12	100

**Table 5.** Mean values of the smallest angle between the ala-tragus lines with the Occlusal Plane (Atx-OP Angle) in people with down syndrome and that in normal individuals

	Individuals with down syndrome (degrees)	Normal individuals (degrees)
Mean	5.852	2.169
SD	5.367	2.557
N	12	12



**Figure 2.** Diagram of the mean angle of ala-tragus line with the occlusal plane in persons with down syndrome and that in normal Individuals

The analysis of *student* t-test in this study obtained the value  $t = 2.15$  with  $p\text{-value} = 0.043$  ( $p\text{-value} < 0.05$ ). This shows that there are significant differences in the mean angle values of persons with down syndrome and that in normal individuals.

## DISCUSSION

The number of samples of people with down syndrome was not as previously expected since there were difficulties in finding people with down syndrome who were aged 18 years and above. Those aged 18 and above have passed the school age limit, so that only a small number of students in SLB met these age criteria. Besides, most of those with down syndrome who are members of POTADS Bandung were less than 14 years old. The presence of people with down syndrome who meet the inclusion criteria but are not cooperative also led to a limited number of samples obtained.

The criteria for sample age was 18 years and above for women and 20 years and above for men. The age of the research subjects was distinguished between men and women because it was expected

that the growth of the maxillary, mandibular, facial, and surrounding structures of the research subjects had stopped. The cessation of facial growth in men and women is different. Based on the literature, facial growth stops at the age of 15 years for women, while that in men stops at the age 17-18 years.<sup>13</sup> Complete maxillary and mandibular growth stops at the age above 17 years in women and 20 years of age for men.<sup>14</sup> Therefore, the sample age of men and women was made different so that the anatomical points used as a reference in this study are relatively constant benchmark points.

The angular values between the occlusal plane and the ala-tragus line (AT1-OP; AT2-OP; and AT3-OP) are not exactly  $0^\circ$ , both in normal individuals and in people with down syndrome. The results of this study are in accordance with the results of Nayar et al.,<sup>9</sup> Kumar et al.,<sup>10</sup> Chaturvedi et al.,<sup>15</sup> and Dean et al.<sup>16</sup> in that there is no angle value right at  $0^\circ$ . The results of this study show that the ala-tragus line, which is the most parallel to the occlusal plane in a normal individual, is the inferior Al-tragus line (AT3). This is consistent with the finding of the previous researches stating that the line from the lower border of the ala nose to the inferior tragus is the most parallel ala-tragus line to the occlusal plane and can be used as a guide to determine the parallelism of the occlusal orientation plane in dentures fabrication.<sup>9,10,15,16</sup>

The results of the Venugopalan et al.,<sup>11</sup> showed that the occlusal plane in normal individuals with class I and III malocclusions is parallel with the line from the lower border of ala nose to the inferior border of tragus, while the occlusal plane in normal individuals with class II malocclusion is parallel with the line from the lower border of ala nose to the middle border of the tragus. Occlusion classifications in this research were not considered in the research criteria. This was due to the limited number of down syndrome samples. The study by Shaikh et al.<sup>12</sup> showed that normal individuals in the young adult age group (20-35 years) have an occlusal plane that is more parallel to the inferior ala-tragus line, whereas the occlusal plane of the older adult group (36-50 years) is parallel to the middle tragus line. The group of down syndrome

samples and normal individuals in this study belonged only to one age group, that was young adults (18-35 years). The study by Bondekar et al.<sup>17</sup> showed that the middle ala-tragus line is parallel to the occlusal plane. Sadr and Sadr<sup>18</sup> stated that in normal individuals there was no parallel between the occlusal plane and the ala-tragus line in the three tragus points (superior, middle, inferior) because no angle with zero degrees was obtained. The superior ala-tragus line has the smallest angle value and is considered to be the most parallel to the occlusal plane.<sup>18</sup>

The results of this study show that the mean angle of the ala-tragus line in normal individuals is  $2.169^\circ \pm 2.557^\circ$  located on the inferior ala-tragus line. The mean value of the study in Nayar et al,<sup>9</sup> is  $3.914^\circ$ , and Dean et al.,<sup>16</sup> is  $2.94^\circ$  located on the inferior ala-tragus line. The mean value of the study in Sadr and Sadr<sup>18</sup> is  $1.80^\circ \pm 3.12^\circ$  located on the superior ala-tragus line. The Abi-Gohsn et al.<sup>19</sup> showed the Ala-tragus line which is the most parallel to the occlusal plane is the middle ala-tragus line with an angle mean value of  $3.275^\circ \pm 2.54^\circ$ . In this research, the standard deviation value of normal individual is greater than the mean value of the angle of the ala-tragus line ( $2.169^\circ \pm 2.557^\circ$ ). This is attributed to the small number of sample size and the wide range of angle values in normal individual. The number of samples of normal individuals is adjusted by the number of samples of persons with down syndrome. The standard deviation value that is greater than the mean value is also seen in the results of Sadr and Sadr's research<sup>18</sup> ( $1.80^\circ \pm 3.12^\circ$ ).

There was no research to address parallelism of the ala-tragus line with the occlusal plane in persons with down syndrome in the literature, so it was difficult for the researchers to find references. The result in this study shows that the inferior ala-tragus line (AT3) is the most parallel line to the occlusal plane in persons with down syndrome and the normal individual but the mean value of angle in down syndrome ( $5.852^\circ \pm 5.367^\circ$ ) in this study was greater than that of normal individuals ( $2.169^\circ \pm 2.557^\circ$ ). The mean value of persons with down syndrome in this study is greater

than the results of previous studies in normal individuals.<sup>9,16,18,19</sup> The difference in the mean angle value occurs because of an ear abnormality (low set ear), which causes the ears of people with down syndrome to be rotated and lower than those of normal individuals.<sup>20</sup> Low set ear is found in 58.33% of the sample. This result is similar to the study of Azman et al.<sup>21</sup> that is, the low set ear was found in 56.1% of the sample. Low set ear is also found in most of the samples in the study of Podder et al.,<sup>22</sup> that is as much as 71.8%, while the study of Bartelli<sup>23</sup> revealed that low set ear is only found in 16.1% of samples of down syndrome children. The lower ear portion and rotation cause changes in the tragus position that affects the parallelism of the ala-tragus line with the occlusal plane.

Intra-oral examination showed that a small proportion of people with down syndrome in this study had dental agenesis (33.33%) and anomalies in dental morphology (8.33%). This result is similar to the study of Shukla et al.<sup>5</sup> with 33.8% samples having dental agenesis and 45.5% have microdontia abnormalities. The presence of agenesis and tooth shape anomalies in some persons with down syndrome can affect the position of the fox plane in the oral cavity, thereby changing the parallelism of the ala-tragus line with the occlusal plane.

The mean angle formed by the ala-tragus line with the occlusal plane of down syndrome is greater than that of normal individuals. This means that the ala-tragus line in people with down syndrome deviates further than zero degrees compared to that in normal individuals. The ala-tragus line in persons with down syndrome is less parallel to the occlusal plane compared to normal individuals.

The inferior border of the ala nose and ear tragus is an extra oral landmark that can be used as a reference plane to determine the occlusal plane because both are relatively constant and not affected by the aging process. The majority of the previous study showed that the occlusal plane was parallel to the inferior ala-tragus line<sup>9-12,15,16</sup> but some other studies demonstrated that the occlusal plane is parallel to the superior ala-tragus line<sup>18</sup> and middle.<sup>11,12,17,19,24</sup> The occlusal plane parallelism should be determined not only

from one anatomical landmark but also from a combination of other anatomical landmarks.<sup>24</sup> The other anatomical landmark that can be used as a guide for determining the occlusal maxillary plane is the hamular notch- papillary incisor.<sup>25-28</sup>

Jain and Shigli<sup>24</sup> stated that more than one anatomic landmark is needed to determine the occlusal plane accompanied by clinical assessment to obtain the ideal occlusal plane. Nayar et al.,<sup>9</sup> stated that the determination of the occlusal plane, besides using reference anatomic landmarks also required clinical assessment that prioritized aesthetic satisfaction, function, and stability of dentures. Further research is needed regarding the parallelism of ala tragus line with the occlusal plane, with a larger number of samples to find alternative anatomical landmarks that can be used as reference plane to determine occlusal plane parallelism in normal individuals and that in persons with down syndrome.

## CONCLUSION

Based on the research, it can be concluded that the parallelism between the ala-tragus line and the occlusal plane in people with down syndrome is different from that in normal individuals. The inferior Al-tragus line in normal individuals is more parallel to the occlusal plane as compared to that of people with down syndrome.

## REFERENCES

1. Dorland N. Dorland's illustrated medical dictionary 32<sup>nd</sup> ed [internet]. Philadelphia: Saunders an Elsevier Imprint; 2012 [cited 2019 May 23]. Available from: [www.mobysystems.com](http://www.mobysystems.com)
2. Kelminson KL, Elias ER, Goldson E. Down syndrome. In: Berman's pediatric decisions making 5<sup>th</sup> ed [Internet]. Philadelphia: Elsevier Mosby; 2011. 680.
3. Asmiyati, Nurhayati, Herlina. Karakteristik sikap ibu dengan kejadian sindrom down. *J Health Quality*. 2012; 3(1): 1-9.
4. The national institute of dental and craniofacial research. Practical oral care for people with down syndrome. Bethesda: NIH Publication; 2009. 1-8.
5. Shukla D, Bablani D, Chowdhry A, Thapar R, Gupta P, Mishra S. Dentofacial and cranial changes in down syndrome. *Osong Public Health Perspect*. 2014; 5(6): 339-344. doi: 10.1016/j.phrp.2014.09.004
6. Saporano PC, Deguchi T, Lee DJ. Implant therapy for a patient with down syndrome and oral habits: a clinical report. *J. Prosthet Dent*. 2016; 116(3): 320-324. doi: 10.1016/j.prosdent.2016.01.019
7. Shetty S, Zargar NM, Shenoy K, Rekha V. Occlusal plane location in edentulous patients: a review. *J Indian Prosthodont Soc*. 2013; 13(3): 142–148. doi: 10.1007/s13191-013-0288-0
8. The Academy of Prosthodontics. The glossary of prosthodontic terms 9<sup>th</sup> Ed. *J Prosthet Dent*. 2017; 117(5S): e8. doi: 10.1016/j.prosdent.2016.12.001
9. Nayar S, Bhuminathan S, Bhat WM, Mahadevan R. Relationship between occlusal plane and ala-tragus line in dentate individuals: a clinical pilot study. *J Pharm Bioallied Sci*. 2015; 7(1): S95-97. doi: 10.4103/0975-7406.155822
10. Kumar S, Garg S, Gupta S. A determination of occlusal plane comparing different levels of the tragus to form ala tragal line or camper's line: A photographic study. *J Adv Prosthodontic*. 2013; 5(1): 9-15. doi: 10.4047/jap.2013.5.1.9
11. Venugopalan SK, SatishBabu CL, Rani MS. Determination of the relative paralelisme of occlusal plane to three ala tragal lines in various skeletal malocclusions: a cephalometric study. *Indian J Dent Res*. 2012; 23(6): 719-725. doi: 10.4103/0970-9290.111246
12. Shaikh SA, Lekha K, Mathur G. Relationship between occlusal plane and three levels of ala tragus line in dentulous and partially dentulous patients in different age groups: a pilot study. *J Clin Diag Res*. 2015; 9(2): 39-42. doi: 10.7860/JCDR/2015/11820.5575
13. Junior JC, Almeida RCC. Orthosurgical treatment of patients in the growth period: at

- what cost. *Dental Press J Orthod.* 2012; 17(1): 159-177.  
doi: 10.1590/S2176-94512012000100019
14. Heasman P. *Master dentistry: Restorative dentistry, paediatrics dentistry, and orthodontics.* 2<sup>nd</sup>ed [Internet]. Edinburgh: Elsevier; 2008. 215.
  15. Chaturvedi S, Thombare R. Cephalometrically assessing the validity of superior, middle and inferior tragus point on ala tragus line while establishing the occlusal plane in edentulous patient. *J Adv Prosthodont.* 2013; 5(1): 58-66. doi: 10.4047/jap.2013.5.1.58
  16. Dean DSS, Reader SD, Vaishnav K, Naik SS. Evaluation of different points of tragus as posterior reference point for camper's plane: a photographic analysis. *Indian Journal of Applied Basic Medical Sciences.* 2015; 17(24): 45-53.
  17. Bondekar V, Wagh SB, Attal PN, Pandey VR. Evaluation of relation between occlusal plane and ala-tragus line with the help of cephalometry. *J Adv Med Dent Sci Res.* 2015; 3(6): 543-548.
  18. Sadr K, Sadr M. A study of parallelism of the occlusal plane and ala tragus line. *J Dent Res Dent Clin Dent Prospect.* 2009; 3(4): 107-109. doi: 10.5681/joddd.2009.027
  19. Abi-Ghosn C, Zogheib C, Younes R, Makzoum JE. The ala-tragus line as a guide for orientation of the occlusal plane in complete dentures. *J Contemp Dent Pract.* 2014; 15(1): 108-111. doi: 10.5005/jp-journals-10024-1497
  20. Nakano S, Makishima H, Yamada S. *Congenital anomalies in human embryos.* London: Intech Open; 2018. 30. doi: 10.5772/intechopen.72628
  21. Azman BZ, Ankathil R, Siti MI, Suhaida MA, Norhashimah M, Tarmizi AB, NorAMA, Kannan TP, Zilfalil BA. Cytogenetic and clinical profile of down syndrome in Northeast Malaysia. *Singapore Med J.* 2007; 48(6): 550-554.
  22. Podder G, De A, Adhikari A, Halder A, Banerjee J, De M. Assessment of Down Syndrome patients in west bengal india. *Pacific J Med Sci.* 2012; 10(2): 28-35.
  23. Bertelli ECP, Biselli JM, Bonfim D, Bertollo EMG. Clinical profile of children with down syndrome treated in a genetics outpatient service in the southeast of brazil. *Rev Assoc Med Bras.* 2009; 55(5): 547-542. doi: 10.1590/S0104-42302009000500017
  24. Jain R, Jain, Shigli K. An in vivo study to correlate the relationship of the extraoral and intraoral anatomical landmarks with the occlusal plane in dentulous subjects. *Indian J Dent Res.* 2015; 26(2): 136-142.
  25. Thapa D. Evaluation of the reliability of hamular notch-incisive papilla plane (hip) in establishing occlusal plane. *Ortho J Nepal.* 2014; 4(1): 45-47. doi: 10.3126/ojn.v4i1.11311
  26. Singh K, Lakshmi N, Agnihotri Y, Suvarna SR, Sahoo S, Kumar P. Three-dimensional analysis to compare parallelism of occlusal planes to the hamular notch-incisive papilla plane in dentulous and edentulous subjects. *Eur J Gen Dent.* 2013; 2(3): 286-291.
  27. Tambake D, Shetty S, Babu CLS, Fulari SG. Analysis of Relative Parallelism Between Hamular-Incisive-Papilla Plane and Campers Plane in Edentulous Subjects: A Comparative Study. *J Indian Prosthodont Soc.* 2014; 14(1): 132-136. doi: 10.1007/s13191-014-0382-y
  28. Kaur K, Nelogi SY, Patil R. Comparative evaluation of the most reliable posterior reference point of Camper's plane in relation with hamular notch-incisive papilla plane with change in gender of edentulous subjects: A cephalometric study. *Indian J O Health Sci.* 2016; 9(2): 45-47. doi: 10.4103/2349-5006.191259