Research Article

Radiomorphometric evaluation of mandibular parameters for sexual dimorphism in individuals with down syndrome

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Abstract: Background: The mandible is often used in forensic investigations due to its resistance to post-mortem damage and its potential to show sexual dimorphism. However, the growth patterns of the craniofacial structure in individuals with Down syndrome (DS) differ from those in the general population, which may affect the manifestation of mandibular dimorphism. Objective: This study aimed to evaluate sexual dimorphism in mandibular radiomorphometric parameters in individuals with and without Down syndrome using panoramic radiography. Methods: This analytical observational study utilized a cross-sectional design. A total of 26 panoramic radiographs from individuals aged 10 to 17 years were analyzed, including 13 individuals with Down syndrome and 13 without. Measurements of bicondylar width, mandibular symphysis height, and the vertical position of the mental foramen in relation to the inferior mandibular border were performed using Clinicview 10.2.6 software. Independent t-tests or non-parametric equivalents were used to analyze the differences between males and females, as appropriate. A post hoc power analysis was conducted to assess the adequacy of the sample size. Results: No statistically significant sexual dimorphism was found in bicondylar width, mandibular symphysis height, or mental foramen position among individuals with Down syndrome ($p > 0.05$). In contrast, significant sex-related differences were identified in the vertical position of the mental foramen in individuals without Down syndrome ($p < 0.05$). Effect size analysis indicated small to moderate differences in certain parameters; however, post hoc power analysis revealed low statistical power, indicating limited ability to detect subtle differences. Conclusion: The mandibular parameters assessed in this study revealed limited sexual dimorphism in individuals with Down syndrome. These findings suggest that bicondylar width, mandibular symphysis height, and mental foramen position should be interpreted with caution in a forensic context within this population.

Keywords: Down syndrome, Forensic dentistry, Panoramic radiography, Sexual dimorphism

Introduction

Identification of individuals in mass disasters is highly complex due to the severe damage, charring, and decomposition [1]. Most deceased victims lack identification, necessitating victim identification, including sex identification [2]. The occurrence of a mass disaster in a region requires careful consideration because not everyone can easily escape, such as the elderly, pregnant women, children, and people with intellectual disabilities (Down syndrome). Deceased victims are difficult to identify, necessitating the involvement of forensic experts. Identifying deceased victims in a mass disaster requires collaboration across various professions and disciplines. One frequently used approach is the comparison of mandibular morphometrics, as the mandible is considered relatively resistant to post-mortem damage

and retains morphological characteristics that can indicate differences in sex, age, and population origin. The mandible exhibits the highest sexual dimorphism among the facial bones. Mandibular dimorphism varies depending on race, age, and masticatory muscle activity [3]. Various mandibular parameters, including bicondylar breadth, mandibular symphysis height, and mental foramen position, have been explored as indicators of sexual dimorphism, with results showing variation between populations and between radiographic measurement methods [4].

Mandibular growth is a constant remodeling process [5]. Bone apposition and resorption that occur with aging cause changes in mandibular shape and size [6]. Several factors, including genetics, hormones, nutrition, socioeconomic factors, and climate, influence human mandibular bone growth. Diseases can delay or accelerate bone growth. One genetic factor that can affect mandibular growth is Down syndrome. In people with Down syndrome, a prognathic mandible is often found, caused by deficient maxillary formation that does not keep pace with mandibular growth [7]. A distinctive craniomaxillofacial growth pattern, including a tendency for a smaller mandibular ramus and corpus, facial deformities, and delayed tooth maturation and eruption, characterizes Down syndrome (trisomy 21). Morphometric differences in individuals with Down syndrome are not only important for clinical planning in dentistry and orthodontics but also have implications for forensic identification efforts, as these morphological abnormalities can affect the accuracy of sex determination methods developed for the general population [8,9,10].

Research on maxillary and mandibular bone morphometrics has been extensively conducted in controls and is limited in individuals with Down syndrome. Several previous studies on Down syndrome through mandibular anatomy only focused on measuring the parameters of the length of the mandibular corpus, the size of the mandibular gonial angle, and the total height of the mandibular ramus [11,12]. This condition becomes a gap in scientific studies to evaluate the accuracy of the parameters used in the Down syndrome population, especially regarding the bicondylar width, the height of the mandibular symphysis, and the position of the mental foramen, the results of which can be applied not only for the application and development of forensic odontology in clinical but also provide a deeper understanding of the unique craniofacial characteristics of people with Down syndrome. Despite increasing interest in forensic dental radiology, limited evidence exists regarding mandibular morphometry in individuals with Down syndrome, particularly using panoramic radiographic measurements.

Materials and Methods

Study Design and Settings

This type of research is an analytical observational study with a cross-sectional approach that aims to analyze the position of the mental foramen, bicondylar width, and height of the mandibular symphysis, between men and women in controls and those with Down syndrome, using panoramic radiography in the dental radiology laboratory of RSGM University of Jember. Sampling used a non-probability sampling technique with a purposive sampling method. The research subjects were 13 controls and 13 people with Down syndrome from SLB Negeri Patrang Jember. Ethical approval for this research has been obtained from the Medical Research Ethics Committee of the Faculty of Dentistry, University of Jember, with number 3224 / UN25.8 / KEPK / DL / 2025. The subjects of this research were 10-17-year-olds who had signed an informed consent for further panoramic X-rays. A post hoc power analysis was conducted using G*Power software (α = 0.05) to evaluate the adequacy of the sample size. Measurement of the position of the mental foramen, bicondylar width, and height of the mandibular symphysis was carried out using the Clinicview 10.2.6 application. Panoramic radiographs were obtained using a digital orthopantomography unit an Andini Orthomograph OP 200D, manufactured in 2019. To minimize magnification bias inherent in panoramic radiography, all images were obtained using the same machine under standardized positioning protocols. Measurements were performed digitally using consistent reference points to ensure comparability across samples. A calibrated examiner performed all measurements, and repeated measurements were conducted on randomly selected radiographs to ensure

consistency. Inclusion criteria included diagnostically acceptable panoramic radiographs with no motion artifacts or severe distortion. Intra-observer reliability was assessed by repeating measurements on a subset of samples after a two-week interval, and the results were analyzed using intraclass correlation coefficients (ICC).

Determining the Position of the Mental Foramen

Perform panoramic photo analysis to measure the length and position of the mental foramen. This is done by measuring the distance between the superior point of the mental foramen and the inferior point of the mandible (S-L) and the distance between the inferior point of the mental foramen and the inferior point of the mandible (I-L) using the Clinicview 10.2.6 application, as shown in Figure 1.

Measuring the height of the mandibular symphysis

The height of the mandibular symphysis is calculated by measuring the distance from the infradentale point (Id) to the gnathion point (Gn) to form a line, as shown in Figure 1. Measurements are made using the Clinicview 10.2.6 application.

Measuring Bicondylar Width

Bicondylar width is measured by drawing the most lateral point between the two condyles to form a line (A-B), as shown in Figure 1. Measurements are performed using the Clinicview 10.2.6 application.

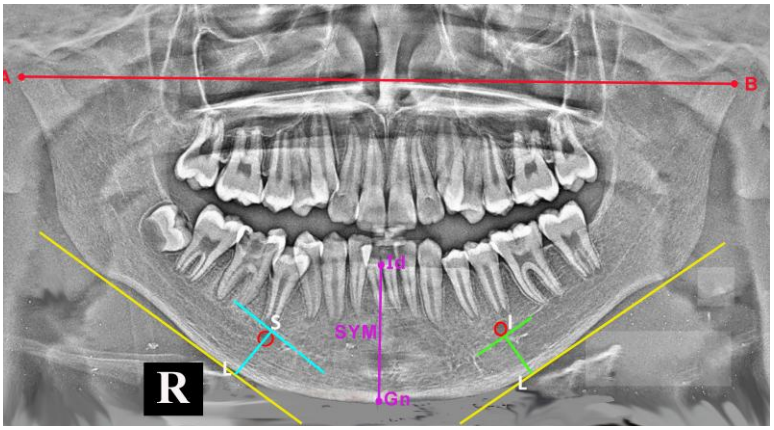

Figure 1: Determining the position of the mental foramen, measuring the height of the mandibular symphysis, and measuring bicondylar width

Data Analysis

The obtained data were tabulated and subjected to an independent t-test using SPSS version 22 software. Descriptive statistics, mean comparisons, and exploratory statistical tests were performed to identify potential morphometric differences between groups. These analyses were intended to evaluate structural variation rather than to construct predictive sex-classification models.

Result

Overall, morphometric measurements were generally lower in individuals with Down syndrome compared with individuals without Down syndrome, while differences between males and females were less pronounced in the Down syndrome group. Results of Post hoc statistical power analysis revealed low statistical power across all evaluated parameters, with values of approximately 0.33 for bicondylar width, 0.20 for mandibular symphysis height, and 0.05 for mental foramen position.

Mental Foramen Position

The results of calculating the mental foramen position in Down syndrome patients and controls are presented in Table 1 and 2.

Table 1: Vertical position of the mental foramen relative to the inferior mandible in Down syndrome and controls

Group	Sex	N	Vertical Position of Mental Foramen to Inferior Mandible ± SD (mm)		
			SL	IL	Mean SL-IL
DS	Male	6	9.05 ± 2.71	7.39 ± 2.26	7.45 ± 2.67
DS	Female	7	8.85 ± 2.30	8.02 ± 2.12	7.46 ± 2.14
Nr	Male	6	13.48 ± 0.13	9.21 ± 1.32	11.28 ± 0.75
Nr	Female	7	12.35 ± 1.08	7.97 ± 1.58	9.93 ± 1.31

DS=Down syndrome; Nr=Normal; SL=Superior foramen mentale–inferior mandibula; IL=Inferior foramen mentale–inferior mandibular; SD=Standard deviation

Table 1 shows that the vertical position of the mental foramen relative to the inferior mandible in males with Down syndrome is smaller compared to normal males, while in females with Down syndrome, the vertical position of the mental foramen is also smaller compared to normal females and the vertical position of the mental foramen in males with Down syndrome is smaller compared to females with Down syndrome.

Based on the results of the independent t-test in Table 2, it shows that there is no significant difference in the vertical position of the mental foramen relative to the inferior mandible in male Down syndrome sufferers compared to female Down syndrome sufferers, but this is not the case in normal children where the position of the mental foramen in normal male children is significantly different from that in normal female children. Table 2 also shows that there is a significant difference in the position of the mental foramen between children with Down syndrome and normal children.

Table 2: Results of the independent t-test of the vertical position of the mental foramen against the inferior mandible in children with Down syndrome and normal children

Group	*P*-value											
	DS M SL	DS M IL	DS F SL	DS F IL	Nr M SL	Nr M IL	Nr F SL	Nr F IL	DS M	DS F	Nr M	Nr F
DS M SL	-	0.142	0.993	-	0.511	-	-	-	-	-	-	-
DS M IL	-	-	-	0.996	-	0.057	-	-	-	-	-	-
DS F SL	-	-	-	0.037*	0.001*	-	0.010*	-	-	-	-	-
DS F IL	-	-	0.037*	-	-	0.011*	-	0.111	-	-	-	-
Nr M SL	-	-	-	-	-	0.002*	0.013*	-	-	-	-	-
Nr M IL	-	-	-	-	0.002*	-	-	0.129	-	-	-	-
Nr F SL	-	-	-	-	-	-	-	0.000*	-	-	-	-
Nr F IL	-	-	-	-	-	-	0.000*	-	-	-	-	-
DS M	-	-	-	-	-	-	-	-	-	0.993	0.015*	0.058
DS F	-	-	-	-	-	-	-	-	0.993	-	0.004*	0.023*
Nr M	-	-	-	-	-	-	-	-	0.015*	0.004*	-	0.049*
Nr F	-	-	-	-	-	-	-	-	0.058	0.023*	0.049*	-

DS=Down syndrome; Nr=Normal; M=Male; F=Female; SL=Superior foramen mentale–inferior mandibula; IL=Inferior foramen mentale–inferior mandibular

Height of the Mandibular Symphysis

The results of the calculation of the height of the mandibular symphysis are presented in Table 3 and 4.

Table 3: The results of measuring the height of the mandibular symphysis in Down syndrome and normal groups

Group	Sex	N	Height of the Mandibular Symphysis (Σ±SD) (mm)
DS	**Male**	7	20.17 ± 5.61
DS	**Female**	6	17.68 ± 6.5
Nr	**Male**	7	27.98 ± 2.88
Nr	**Female**	6	23.86 ± 5.14

DS=Down syndrome; Nr=Normal; ∑=Mean; SD= Standard deviation

Table 3 shows that the height of the mandibular symphysis of male Down syndrome sufferers is higher than that of female Down syndrome sufferers, the height of the mandibular symphysis of normal male subjects is higher than that of normal female subjects, the height of the mandibular symphysis of normal male subjects is higher than that of male Down syndrome sufferers, and the height of the mandibular symphysis of normal female subjects is higher than that of female Down syndrome sufferers.

Table 4: Results of the T-test on Down syndrome and normal groups

	P-value			
Group	**DS Male**	**DS Female**	**Nr Male**	**Nr Female**
DS Male	-	0.474	0.007*	-
DS Female	0.474	-	-	0.098
Nr Male	0.007*	-	-	0.096
Nr Female	-	0.098	0.096	-

DS=Down syndrome; Nr=Normal

Based on the results of the Independent T-test in Table 4, it shows that there is a significant difference in the height of the mandibular symphysis between male Down syndrome and normal male subjects. However, there is no significant difference between male Down syndrome and female Down syndrome or between normal male and normal female subjects. Table 4 also shows that there is no significant difference between female Down syndrome and normal female subjects.

Bicondylar Width

The results of the bicondylar width measurements and analysis are presented in Tables 5.

Table 5: Results of the bicondylar width measurements and analysis between Down syndrome and normal groups

Group	N	Bicondylar Width (∑ ± SD) mm	Statistical Test	P-value
DS Male	6	131.70 ± 29.43	Independent t-test	0.346
DS Female	7	114.6 ± 32.51		
Nr Male	6	133.66 ± 49.73	Mann–Whitney U test	0.886
Nr Female	7	147.65 ± 30.63		
DS Male	6	114.6 ± 32.51	Mann–Whitney U test	0.513
Nr Male	6	133.66 ± 49.73		
DS Female	7	114.6 ± 32.51	Mann–Whitney U test	0.77
Nr Female	7	147.65 ± 30.63		

DS=Down syndrome; ∑=Mean; Nr=Normal

Table 5 shows that the average bicondylar width in the Down syndrome group was lower than in the normal group. In the Down syndrome group, the bicondylar width in male was higher than in female,

while in the normal group, the bicondylar width in male was lower than in female. The results of the independent T test in Table 5 show a significance value greater than 0.05, indicating that there is no significant difference in bicondylar width between male and female with Down syndrome. Meanwhile, the results of the Mann-Whitney U test in Table 5 show a significance value greater than 0.05, indicating that there is no significant difference in bicondylar width between male and female in both the Down syndrome and normal groups.

Discussion

It is important to clarify that this study does not seek to create a predictive model for estimating biological sex. Instead, the findings offer exploratory radiomorphometric insights that could enhance future forensic investigations, especially in populations with altered craniofacial development, such as individuals with Down syndrome. From the perspective of dental radiology, these findings suggest that the structural variability of mandibular parameters may be influenced more by developmental conditions than by biological sex alone.

The results of the bicondylar width analysis in Down syndrome patients showed no significant differences between males and females. These results are consistent with other studies on the mandible bone in Down syndrome patients, namely regarding the length of the corpus and height of the mandibular ramus [12]. This result is possible because Down syndrome patients experience a reduction in maxillary length, midface hypoplasia, a reduction in the length of the cranial base, and a reduction in mandibular length due to the smaller size of the ramus and corpus of the mandible. The significant overall reduction in craniofacial dimensions in Down syndrome patients results in less significant differences between the normal and Down syndrome groups [13].

In individuals with Down syndrome, there is dysfunction in the Growth Hormone–Releasing Hormone (GHRH)–Growth Hormone (GH)–Insulin-Like Growth Factor 1 (IGF-1) axis. This disorder causes suboptimal growth because the body is unable to convert GH-independent IGF-2 into GH-dependent IGF-1. This conversion failure is thought to be related to abnormalities in GH synthesis, secretion, and action on its receptors. Consequently, IGF-1 production is low. These low IGF-1 levels have the potential to limit bone tissue's response to sex hormones, resulting in suboptimal skeletal growth patterns, including sexual dimorphism, in individuals with Down syndrome [14]. This skeletal growth mechanism may also apply to mandibular growth in individuals with Down syndrome. Bicondylar width measurements indicate that males with Down syndrome have a greater bicondylar width than females, although this difference is not significant. These results align with Thomas's (2020) study on Down syndrome model mice, which showed that BV/TV (Bone Volume per Tissue Volume) values, an indicator of accrual and trabecular density, decreased in both sexes, but the pattern differed between male and female mice.

During active growth, BV/TV values decreased in both sexes of Down syndrome model mice. However, female mice, both Down syndrome and normal mice, showed lower BV/TV values than normal male mice. This condition continued until approaching skeletal maturity, with female Down syndrome mice having lower BV/TV values than male Down syndrome mice, while male mice experienced an increase in BV/TV values. This pattern indicates that females experience greater bone accrual inhibition. These findings align with reports in humans where adolescent females with Down syndrome tend to have lower bone density than males and reach peak bone mass earlier but at a lower rate [15].

The results of the mandibular symphysis study showed a significant difference between the height of the mandibular symphysis in male Down syndrome patients and normal male subjects, but there was no significant difference in female Down syndrome patients with normal female subjects. This condition is likely due to a geometric reduction in the effective length of the midface and mandible in the Down syndrome population [16]. In this study, it was seen that individuals with Down syndrome tend to experience different mandibular growth compared to controls.

Growth and development disorders that cause a geometric reduction in mandibular length in Down syndrome patients occur due to the presence of an additional chromosome 21. This excess chromosome contains several excess genes that cause an abnormal increase in the production of certain proteins in the cells. This condition disrupts the normal growth process in the bodies of fetuses with Down syndrome [17]. This difference is also caused by hormonal deficiencies, namely a lack of growth hormone (somatotropin) and insulin-like growth factor 1 (IGF-1), which affect the growth process from early life. IGF-1 deficiency not only inhibits tissue and bone development but also causes weakness in the muscular system, which impacts muscle strength and function.

Other hormones, such as thyroid hormone and glucocorticoid, also play an important role in the growth process. Thyroid hormone functions to stimulate the body's metabolism and support tissue growth, while glucocorticoids help stimulate the growth of interstitial cells in the testes to produce testosterone, and stimulate the ovaries to produce estrogen, which plays a role in the development of secondary sexual characteristics [18]. Calculations of the mandibular symphysis height in people with Down syndrome showed no significant difference between males and females. Likewise, calculations of the mandibular symphysis height in normal subjects in this study showed no significant difference between males and females. In this study, the average age of the sample was at puberty, so this occurs because bone growth and biological maturation that occur during puberty are dynamic processes regulated by genetic, cellular, and environmental factors. Cellular factors that influence bone growth during puberty are chondrocyte proliferation and differentiation. This process slows with age, and when chondrocyte proliferation stops, growth also stops in adulthood [19].

Another influencing factor is the different growth patterns of everyone, and one important factor is Sex. Indeed, sex influences growth rate, growth time, and skeletal and dental maturity. Differences in puberty timing between males and females impact skeletal maturity. Peak growth in females occurs earlier than in males, and skeletal growth in females is rapid and short, while in males it is slower but longer [19]. According to research conducted by Azhari (2019), the mandible is also larger in males than in females. This difference in mandible size is caused by different bone remodeling activities, which are influenced by genetic factors, muscle mass, and differences in sex hormones secreted in males and females.

The results of this study also showed that the position of the mental foramen in males with Down syndrome and females with Down syndrome showed no significant difference. This is possible due to the delay in growth of Down syndrome sufferers. Males with Down syndrome reach pubertal growth spurt at the age of 11-16 years, while females with Down syndrome at the age of 9-12 years. Females with Down syndrome reach pubertal growth spurt 1 year earlier than controls and with a shorter duration, so their peak growth stops earlier. This causes the final height of females with Down syndrome to be shorter than males [20].

Maximum growth during puberty in terms of height is strongly correlated with maximum growth in the condylar bone [21]. The results of this study are in line with previous research on the mandibular bone, namely the length of the mandibular corpus in males with Down syndrome and females with Down syndrome, which showed no significant difference [12]. In this study, the position of the mental foramen in children with Down syndrome and normal children showed significant differences. These results are consistent with previous research stating that excess chromosomes in children with Down syndrome will affect mandibular growth, resulting in significant differences in the position of the mental foramen between children with Down syndrome and normal children, both males and females. People with Down syndrome show decreased bone formation in the mandible, which can cause a different mandibular shape. People with Down syndrome also experience differences in the timing and growth of the mandible, which is delayed by about two years compared to the general population. Abnormal mandibular growth can impact the position of the mental foramen in children with Down syndrome [22, 23]. Low levels of the sex hormones androgen and estrogen may also cause impaired

mandibular growth [24]. People with Down syndrome have abnormalities in both craniofacial structures. Craniofacial manifestations of Down syndrome include brachycephaly, a condition in which the head is disproportionately sized, a reduced upper face, a reduced mandibular depth and width, a sagittal defect in the mandible to the maxilla and to the upper face, and both the upper and lower faces tend to protrude.

The small mandible in Down syndrome is caused by the displacement and spread of damage to the mandibular neural crest cells during embryonic development, preventing the mandible from forming properly. These two factors are thought to cause the facial height in children with Down syndrome to be lower than that of normal children, resulting in a distinctive facial shape in both males and females [25]. The results of this study also showed that the position of the mental foramen in normal males and normal females differs significantly. This is in accordance with the theory that the male mandible has a larger morphology and size than that of females. The growth spurt in females begins two years earlier than in males, at age 12. This causes the growth period of females to finish earlier than males, so the total growth period of males is longer than females. Males have a higher growth potential than females because the adolescent growth spurt in males is greater than in females. In addition, males have two additional years of growth due to differences in maturation. Males also experience a greater mandibular growth spurt at puberty than females due to more active hormonal influences in males. So the vertical position of the mental foramen to the inferior mandible in normal males is greater than in normal females [26]. The results of this study are in accordance with previous research conducted by Hardani et al. (2016), which stated that the distance S-L (Superior mental foramen to inferior mandible) and I-L (Inferior mental foramen to inferior mandible) in males is significantly greater than in females.

From a clinical dental radiology perspective, it is crucial to understand the morphometric variations seen in syndromic populations. This understanding helps avoid the misinterpretation of radiographic measurements that were originally based on non-syndromic reference standards. The findings of this study highlight the usefulness of panoramic radiography as a practical screening tool in dental radiology, while also underscoring the need for careful interpretation of morphometric data in patients with developmental conditions. This study provides essential baseline observations regarding radiomorphometry, which could aid future multicenter research and enhance mandibular assessment protocols for special populations.

Limitations

The lack of significant morphometric differences should not be viewed as indicative of minimal clinical value. Instead, it emphasizes the biological variability associated with altered craniofacial development and highlights the importance of interpreting results in a condition-specific manner. The findings of this study support previous radiographic observations suggesting that growth patterns in syndromic craniofacial development may diminish the conventional morphometric differences typically seen in healthy populations. However, this study has several limitations. The relatively small sample size resulted in low statistical power, which may have limited the detection of subtle sexual dimorphism in the studied parameters. Additionally, the participants were aged 10 to 17 years, a time of active craniofacial growth, and delayed growth patterns in Down syndrome may further complicate the assessment of sexual dimorphism. Therefore, the results should be regarded as exploratory. Moreover, the statistical methods employed in this study were focused on exploratory comparisons rather than predictive modeling. As a result, the findings should be understood as preliminary morphometric observations, rather than definitive criteria for forensic classification.

Conclusion

In this exploratory radiomorphometric study, the measurements of bicondylar width, mandibular symphysis height, and the position of the mental foramen showed limited structural differences in individuals with Down syndrome. These findings indicate that conventional mandibular metrics should

be interpreted with caution in forensic contexts. They also emphasize the necessity for further studies utilizing larger samples and more advanced analytical models.

Conflict of interest

The authors have no conflicts of interest to declare.

Ethics approval and consent to participate

Ethical clearance was obtained from the Research Ethics Committee of the Faculty of Dentistry, University of Jember, number 3224/UN25.8/KEPK/DL/2025.

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Author contributions

DKA; Study conception and design. ADPS, FGK, PRN, and KEO; Data collection. DKA and ADPS; Statistical analysis and interpretation of results. ADPS, RCP, AFM and NF; Writing - review & editing. DKA and ADPS; Supervision. All authors reviewed the results and approved the final version of the manuscript to be published.

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التقييم الإشعاعي لمؤشرات الفك السفلي لإزدواج الشكل الجنسي لدى الأفراد المصابين بمتلازمة داون

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المستخلص

الخلفية: يُستخدم الفك السفلي بكثرة في التحقيقات الجنائية نظرًا لمقاومته للتلف بعد الوفاة وإمكانية إظهاره للاختلافات الجنسية. مع ذلك، تختلف أنماط نمو بنية الجمجمة والوجه لدى الأفراد المصابين بمتلازمة داون عن تلك الموجودة لدى عامة السكان، مما قد يؤثر على ظهور الاختلافات الجنسية في الفك السفلي. الهدف: هدفت هذه الدراسة إلى تقييم الاختلافات الجنسية في معايير قياسات الفك السفلي الشعاعية لدى الأفراد المصابين بمتلازمة داون وغير المصابين بها باستخدام التصوير الشعاعي البانورامي. المنهجية: استخدمت هذه الدراسة التحليلية القائمة على الملاحظة تصميمًا مقطعيًا. تم تحليل 26 صورة شعاعية بانورامية لأفراد تتراوح أعمارهم بين 10 و17 عامًا، منهم 13 مصابًا بمتلازمة داون و13 غير مصابين بها. تم قياس عرض اللقمتين، وارتفاع ارتفاق الفك السفلي، والموضع الرأسي للثقبة الذقنية بالنسبة للحافة السفلية للفك السفلي باستخدام برنامج Clinicview 10.2.6. استُخدمت اختبارات t المستقلة أو ما يعادلها من الاختبارات غير البارامترية لتحليل الفروق بين الذكور والإناث، حسب الاقتضاء. أُجري تحليل قوة إحصائية لاحق لتقييم كفاية حجم العينة. النتائج: لم يُلاحظ أي تباين جنسي ذو

دلالة إحصائية في عرض اللقمتين، أو ارتفاع ارتفاق الفك السفلي، أو موضع الثقبة الذقنية لدى الأفراد المصابين بمتلازمة داون ($p < 0.05$). في المقابل، حُددت فروق ذات دلالة إحصائية مرتبطة بالجنس في الموضع الرأسي للثقبة الذقنية لدى الأفراد غير المصابين بمتلازمة داون ($p < 0.05$). أشار تحليل حجم التأثير إلى وجود فروق طفيفة إلى متوسطة في بعض المعايير؛ ومع ذلك، كشف تحليل القوة الإحصائية اللاحق عن قوة إحصائية منخفضة، مما يشير إلى قدرة محدودة على رصد الفروق الدقيقة. الاستنتاج: كشفت معايير الفك السفلي التي تم تقييمها في هذه الدراسة عن تباين جنسي محدود لدى الأفراد المصابين بمتلازمة داون. تشير هذه النتائج إلى ضرورة توخي الحذر عند تفسير عرض اللقمتين، وارتفاع ارتفاق الفك السفلي، وموضع الثقبة الذقنية في السياق الجنائي ضمن هذه الفئة.