Craniofacial anatomy is the study of the structure and relationships of the cranial, facial, and maxillofacial bones. It is an essential aspect of dental and medical education, as it helps in understanding the development and growth of the head and face and the potential implications for health and function. Craniofacial malformations can lead to abnormal growth patterns, which may result in functional and aesthetic abnormalities. These abnormalities can be related to various medical conditions, such as genetic disorders, birth defects, and developmental anomalies. The craniofacial skeleton is composed of a complex interplay of bones that form the skull, face, and jaw. The patterns of growth and development of these bones are influenced by various factors, including genetics, environment, and nutrition. The study of craniofacial anatomy is crucial for the effective diagnosis and management of disorders related to the craniofacial region. 

The structure and function of the craniofacial region are closely interconnected, and any abnormality that affects one part of the region can have implications for the other parts. For example, a malformation of the nasal bones can lead to respiratory problems, while a malformation of the maxillary bones can affect the development of the teeth and jaws. Therefore, a comprehensive understanding of craniofacial anatomy is essential for the effective diagnosis and treatment of craniofacial disorders. 

In conclusion, craniofacial anatomy is a vital aspect of dental and medical education, and it plays a critical role in the effective diagnosis and management of disorders related to the craniofacial region. A thorough understanding of craniofacial anatomy is essential for the effective treatment of dental and medical conditions related to the craniofacial region.
Angle’s classification of malocclusion [14]. The divisions 1 and 2 of Class II malocclusions were combined. Craniofacial measurements i.e. maximum head length (HL) and head breadth (HB) were measured for each subject using Martin spreading calipers centered on standard anthropological methods. The craniofacial measurements were taken according to the technique defined by Kalia et al. [15]. The head length was measured as the straight distance between from opisthocranion to glabella and head width was measured as the distance between two most lateral points of the skull above the level of supramastoid crest at right angles to the median sagittal plane. Subsequently, cephalic Index (CI) was calculated using the formula head breadth/head length X 100. All the examinations were carried out by two dentists, however, throughout the examinations, every 10th child was re-examined independently by each examiner to test for possible intra- and interobserver variation, which was less than 5% for each of the studied variables. Recording procedures were carried out according to the criteria described by WHO [16].

Statistical Methods

Chi-square tests were used to test the variation of the prevalence among groups and for testing the associations of the background factors (age groups, gender, type of disability etc.). One-way Analysis of Variance (ANOVA) was used to analyse the differences in the mean scores of cranial parameters. The associations of various socio-demographic and other factors with the occurrence of malocclusion and cranial parameters were assessed using multivariate analysis (logistic regression). Odds ratios (OR) with 95% confidence interval (95% CI) were estimated for the studied background factors in relation to the occurrence of malocclusion. The following factors were included in the logistic regression model: age, gender, and type of disability. The statistical analyses were performed on SPSS 10.0 software package (SPSS Inc., Chicago, Illinois, USA).

Results

Out of 310 individuals selected for the study, 258 (83%) patients could be examined. The rest did not cooperate for an oral examination. Depending on the type of disability, patients were classified into five groups mental retardation (MR) (n=168), autistic disorder (AD) (n=24), down syndrome (DS) (n=30), cerebral palsy (CP) (n=15) and other (OTH) (hemiplegia, spinal muscular atrophy, dysmorphic syndrome, hydrocephaly, goldenhar syndrome (n=21). Patients were further subdivided into four groups according to their age, 1-10 years (n=42), 11-20 years (n=156), 21-30 years (n=51) and 31-40 years (n=9).

The demographic profile of the study population revealed that the majority of the patients were males (n=171; 66%) with age ranging from 6-40 years (Table 1). 7% of the study population had the positive family history for the disease. The prevalence of malocclusion in the overall study population was 83% (Table 2). Individuals with DS had the highest range of malocclusion prevalence (97%), followed by CP (87%), MR (83%), AD (71%) and OTH (71%). In general, maximum Class III malocclusions belonged to DS group (40%) followed by MR group (11%). Moreover individuals with MR were found to have mostly Class I, or normal incisor relationships. High percentage of individuals with CP had Class II malocclusion (40%) compared to other study groups. Further 16.3% presented with fractured anterior teeth primarily central incisor (Table 2). Gender was not associated with traumatized teeth. Of the group with traumatized teeth, 79% had one damaged incisor, 21% had two damaged incisors. Maxillary central incisors were the teeth most often traumatized for all groups (93%) followed by maxillary laterals (4.0%), mandibular centrals (2%) and mandibular laterals (1.0%). Among all the groups fractured teeth were more evident in patients with OTH (57%) and CP (40%).

The descriptive statistics for cranial parameters is depicted in Table 3. The brachycephalic type of head shape was dominant in the DS (60%) and AD (50%), while the mesocephalic type was dominant in the MR (67%) and CP (60%; Table 4). The hyperbrachycephalic type, rare types of head shape observed in this study was dominant in OTH group (52%). The logistic regression analysis revealed that gender is a significant factor in cranial measurements. The head length among cranial measurements was most significantly affected by gender. Though the head length and head width were significantly more in males (P <0.01), the cephalic index showed no significant sex difference.

Discussion

Though in India, only 20-36% of children in general population have been found to have a definitive malocclusion [17], the mentally disabled individuals in the present study had 83% incidence of definitive malocclusion. Additionally, individuals with Down syndrome showed the highest prevalence of malocclusion among all the study groups. This is in strong agreement with previous studies which suggested that DS is a significant risk factor for severe malocclusion [18-21]. Further DS subjects appeared to exhibit highest incidence Angle class III malocclusion when compared to other groups. Our results are consistent with the findings of previous studies [18,19] who reported an increase in Class III malocclusion coexistent with a reduction of Class II cases in patients with DS compared to controls. These results could be due to altered cranial–base relationships [3,22,23], diminished dental arch size, decreased arch length, and reduced maxillary size in Downs syndrome patients [24].

Furthermore Angle class II malocclusions were the most common form of malocclusion in individuals with CP which confirms with the previous studies [5,24,25]. These results could be ascribed to early eruption of primary teeth among CP patients and aberrant tongue and head posture [24,26-28]. Furthermore, it has been established that lip incompetence, and failure of the maxillary orbicularis muscle In CP patients is the cause of excessive overjet in them [29-32].

Another interesting finding in the present study was that tooth fractures were more prevalent in mentally disabled population (16.3%) than in general population in India [2]. Further the prevalence was higher in the 11-20 year age group than the other groups, thus agreeing with the previous study by Shyama et al. [24]. Trauma was found more often in the maxillary central incisors, which is consistent with the findings of the other studies of normal children [29,33,34] suggesting that these teeth are at a greater risk of being traumatized. There is also increased risk of traumatic injuries to the maxillary incisors, due to the higher frequency of extreme maxillary over jet. Angle class II division I malocclusion, short or incompetent upper lip, and accident-proneness of children with disabilities [35]. Additionally CP group showed increased prevalence of fractured teeth which agrees with the findings of Bhowate et al. [36]. This could be due to their increased susceptibility to trauma. Thus preventive measures regarding trauma to the face, jaw, and teeth need to be included in the oral health promotion programs and disseminated to the children with disabilities.

Many researchers emphasized the importance of quantitative evaluation of the morphological changes in mentally challenged individuals [30,31,37,38]. Furthermore, the present study states that the mean cephalic index of the study group is 82% (brachycephalic head shape) though in India there is predominance of mesocephalic
Variables | Mental Retardation | Autism | Downs syndrome | Cerebral palsy | Others | P value
--- | --- | --- | --- | --- | --- | ---
Age 10-Jan | 30 | 3 | 3 | 0 | 6 | >0.05
20-Nov | 87 | 21 | 21 | 15 | 12 | 0.05
21-30 | 42 | 0 | 6 | 0 | 3 | 0.05
31-40 | 9 | 0 | 0 | 0 | 0 | 0.05
Gender Male | 114 | 12 | 27 | 9 | 9 | >0.05
Female | 54 | 12 | 3 | 6 | 12 | >0.05
Family history Present | 9 | 3 | 3 | 0 | 3 | >0.05
Absent | 159 | 21 | 27 | 15 | 18 | >0.05
IQ score Mild (50-70) | 75 | 2 | 21 | 9 | 3 | >0.05
Moderate (35-49) | 78 | 22 | 6 | 6 | 15 | >0.05
Severe (20-34) | 15 | 0 | 3 | 0 | 3 | >0.05
Dentition Permanent | 120 | 15 | 23 | 5 | 10 | >0.05
Deciduous | 9 | 0 | 0 | 0 | 0 | >0.05
Mixed | 39 | 9 | 7 | 10 | 11 | >0.05

Table 1. Demographic characteristics of study population.

| Variables | Mental Retardation n (%) | Autism n (%) | Downs syndrome n (%) | Cerebral palsy n (%) | Others n (%) | P value
--- | --- | --- | --- | --- | --- | ---
Fractured teeth Present | 21 (12.5) | 0 (10) | 6 (40) | 12 (57.1) | >0.05
Absent | 147 (87.5) | 24 (100) | 27 (90) | 9 (60) | 9 (42.9) | >0.05
Malocclusion Class 1 | 108 (64.3) | 9 (37.5) | 16 (56.7) | 7 (46.7) | 9 (42.8) | <0.05
Class 2 | 14 (8.3) | 8 (33.3) | 0 (0) | 8 (40) | 8 (26.8) | <0.05
Class 3 | 18 (10.7) | 0 (0) | 12 (40) | 0 | 0 | <0.05

*p< 0.05 is considered significant

Table 2. Distribution of malocclusion and fractured teeth by type of disability

| Variables | Mental Retardation (Mean±SD) | Autism (Mean±SD) | Downs syndrome (Mean±SD) | Cerebral palsy (Mean±SD) | Others (Mean±SD) | P value
--- | --- | --- | --- | --- | --- | ---
Head breadth 14.0±1.08 | 13.83±1.64 | 14.24±0.86 | 12.45±1.29 | 14.16±0.76 | >0.05
Head length 17.45±1.42 | 16.78±1.47 | 16.94±0.95 | 16.25±1.51 | 16.29±0.81 | >0.05
Cephalic index (%) 79.6 | 82.2 | 84.4 | 76.8 | 86.9 | >0.05

Table 3. Distribution of cranial values by type of disability.

| Variables | Mental Retardation n (%) | Autistic disorder n (%) | Downs syndrome n (%) | Cerebral palsy n (%) | Others n (%) | P value
--- | --- | --- | --- | --- | --- | ---
Dolicocephalic (<74.9) | 9 (5.3) | 03 (10) | 2 (13.3) | 0 | >0.05
Mesocephalic (75-79.9) | 112 (66.7) | 7 (29.3) | 09 (60) | 4 (19) | >0.05
Brachycephalic (80-84.9) | 40 (23.8) | 12 (50) | 18 (60) | 4 (26.7) | 6 (28.6) | >0.05
Hyperbrachycephalic (85-89.9) | 7 (4.2) | 5 (20.7) | 9 (30) | 011 (52.4) | >0.05

Table 4. Distribution of head shapes by type of disability.

Head in both males and females with cephalic index ranging from 76 in males and 77 in females [29,33,34]. Further, the findings of the present study classify the Down syndrome patients as brachycephalic. This is in good accord with the stigmata of Down syndrome reported in the literature. The principal stigmata of DS includes modifications in head size (overall reduction) and shape (brachycephaly with a flattened occipital bone) [31,38-42]. The peculiar aspect of these subjects is partly a result of developmental anomalies of the craniofacial skeleton [43,44]. Subjects with Down syndrome possess a peculiar and immediately recognizable craniofacial aspect [44,45], but a correct assessment of their morphology substantiated by a quantitative evaluation can be used profitably to monitor facial modifications during growth, development, and aging [46-49]. Additionally largest proportion of patients with AD showed brachycephalic head shape. Although preliminary and in need of replication, these results are consistent Deutsch et al. who determined that enlarged head circumference in autism is primarily due to an increase in head width [50]. This was further supported by Tager-Flusberg et al. who concluded that the increased head width in AD would be consistent with enlargement of parieto-temporal cortex and is possibly associated with abnormal development of the visuo perceptual skills mediated by these brain areas [51].

The present study also states that mesocephalic head shape is dominant in MR and CP group and hyperbrachycephalic in OTH group. These results could be attributed to the altered growth rate in patients of various syndromes. The size, growth, and time of maturation may all be distorted, as observed sometimes in healthy individuals also [44,45]. The disparity of head shape also exists in various races and geographical zones which has been ascribed to hereditary factors, environmental influences [31,38,39,42] and also food habits [52]. The absence of quantitative evaluation of the morphological changes in mentally challenged individuals (except Down syndrome) in the literature generally prevents direct comparison with our data.

In India, mentally disabled individuals have a higher prevalence of malocclusion and get less oral care than the general population. There is a great need for the strengthening of Oral health promotion programs...
that will ensure the availability of comprehensive preventive and oral health care for these risk groups. It is imperative that preventive measures be initiated at an early age. Although it may not be possible to obtain an ideal result with treatment, every possible effort should be made to help these individuals to a better functioning dentition. Given the rising number of subjects with disabilities living in the community, the assessment of the characteristics of these persons may be of help to clinicians and researchers. But a larger sample size is recommended in further studies.

References


