Abstract

The study aims at identifying the growth disorders in children and adolescents suffering from Turner (45X0) and Klinefelter syndromes (47XXY), in order to correctly establish subsequent treatment strategies. To this extent, a group of children and adolescents formed of 18 girls (9.5-17.5 year-old) and 8 boys (14.5-18.5 year-old) was investigated.

Analysis of these subjects demonstrated dimensional modifications of the basis of the skull, of the maxillary and mandible length. The absence of a chromosome X or its supranumerary presence influences especially the shape and size of the skull basis, of the mandible and of the intermaxillary relations. Chromosomal X aneuploidy determines dimensional modifications of the anterior and posterior facial height.

Keywords: sexual chromosomes, Turner syndrome, Klinefelter syndrome

INTRODUCTION

The presence of cranial-maxillo-facial manifestations caused by genetic endocrinopathies represents an unavoidable reality. From this perspective, Turner (45X0) and Klinefelter (47XXY) syndromes are highly illustrative, their hypogonadism and hypergonadotropic condition involving, to the same extent, the systemic effects of hypogonadism and of the higher seric levels of the specific hypophysary release hormones (GHRH).

The disorders of skeletal growth specific to the two syndromes require continuous re-evaluation, as the descriptive stage is still to be completed, the present acquisitions revealing some aspects which may act not only as new definition criteria, but also as means of providing new levels of knowledge for their substantiation in the more extended dismorphogenetic context of endocrinopathies.

STUDY AIMS

The study aims at evidencing the disorders of skeletal growth in children and adolescents suffering from Turner and Klinefelter syndromes, on the basis of the results provided by profile teleradiographies.

MATERIALS AND METHOD

The experimental group was formed of children and adolescents, 18 girls with ages between 9.5-17.5 years, affected by Turner syndrome (cariotype 45X0) and 8 boys with ages between 14.5-18.5 years, with Klinefelter syndrome (cariotype 47XXY), hospitalized in the Endocrinology Clinics of the “Sf. Spiridon” Unversitary Hospital of Iași.

Evaluation and interpretation of skeletal modifications in the two genetic diseases here under study were based on profile teleradiographies made in the same radiologic laboratory, after which they were scanned and computer-interpreted.

The results obtained were compared with the angular and linear values registered in a group of clinically healthy children belonging to the same category of age as those of the experimental group.

The analysis considered 8 angular and 7 linear parameters, the reference lines and points being illustrated in figure 1.

RESULTS AND DISCUSSION

The results presented in tables 1-4 show growth perturbations of the skull basis and
SKELETAL MODIFICATIONS IN TURNER AND KLINEFELTER SYNDROMES

modifications in the shape and position of the cranial-facial structures in patients suffering from chromosomal X aneuploidy. The most pronounced effects were registered for the length of mandibular basis and posterior facial height, respectively, in patients with Turner syndrome, and for the length of the maxillary basis, in those with Klinefelter syndrome (1,2) (Tables 2, 3).

Skull basis

Size modifications of the skull basis and movement of the maxillaries in opposite directions are characteristic for both syndromes.

It was observed that the absence of a chromosome X affects the shape of the mandible, while the super-numerary chromosome X influences the deviation of the maxillary sagital relation.

Table 1 - Linear and angular parameters of the skull basis

<table>
<thead>
<tr>
<th>Variable</th>
<th>45X0</th>
<th>46XX</th>
<th>47XXY</th>
<th>46XY</th>
</tr>
</thead>
<tbody>
<tr>
<td>N-S</td>
<td>7.5</td>
<td>71.5</td>
<td>74.5</td>
<td>77.3</td>
</tr>
<tr>
<td>S-Ba</td>
<td>4.5</td>
<td>46.6</td>
<td>50.8</td>
<td>51.7</td>
</tr>
<tr>
<td>NSBa</td>
<td>13.4</td>
<td>130.8</td>
<td>123.3</td>
<td>128.7</td>
</tr>
</tbody>
</table>

Table 2 - Linear and angular parameters of the maxillary

<table>
<thead>
<tr>
<th>Variable</th>
<th>45X0</th>
<th>46XX</th>
<th>47XXY</th>
<th>46XY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANS-PNS</td>
<td>51.4</td>
<td>54.7</td>
<td>55.0</td>
<td>60.3</td>
</tr>
<tr>
<td>SNA</td>
<td>75.2</td>
<td>81.4</td>
<td>85.2</td>
<td>81.9</td>
</tr>
<tr>
<td>NSSpP</td>
<td>10.8</td>
<td>8.9</td>
<td>80.0</td>
<td>3.4</td>
</tr>
</tbody>
</table>

No significant differences were registered in anterior length of the skull basis (S-N) in the two syndromes. The posterior length of the skull basis (S-Ba) was lower, comparatively with the statistical values recorded for healthy children of the same age, suffering from Turner syndrome, while no modifications were observed in those with Klinefelter syndrome.

The SNB angle was modified, in both syndromes, with approximately the same value (5.5 degree), yet in opposite directions (3,5) (fig. 2).

In the cases under analysis, the anterior height of the face showed no modifications, comparatively with that of the healthy subjects (table 3).

The K-Go posterior height is reduced, in both syndromes.

The maxilla (SNA-SNP)

The length of the maxillary was lower in the syndromes here considered, comparatively with the values registered for healthy children of the same age. The maxilla was retrognathic in Turner syndrome (SNA – 72.5 degrees) and prognatic in Klinefelter syndrome (85.2 degrees) (table 2).

The mandible

The basis of the mandible (Go-Pg) and the ascending branch were significantly lower in the
subjects affected by Turner syndrome (fig. 3) while, in Klinefelter syndrome, it was only the length of the ascending branch that was reduced. Mandibular retrognatism was registered in Turner syndrome (SNB – 73 degrees), contrary to the mandibular prognatism observed in Klinefelter syndrome (SNB – 85 degrees).

Intermaxillary relations

The sagittal intermaxillary relations (table 4) are represented by a negative ANB angle in Klinefelter syndrome.

The study reveals the effects of sexual chromosomes at the level of cranio-facial structures. Maxillary shifting in patients with chromosomal aneuploidy X may be related to the modified flexion of the skull basis. A reduced flexion, associated to the absence of a chromosome X, produces bimaxillary retrognatism, while an additional chromosome X produces maxillary and mandibular prognatism, as due to increased flexion.

Table 4 – Linear and angular parameters of the intermaxillary relation

<table>
<thead>
<tr>
<th>Variable</th>
<th>45X0</th>
<th>46XX</th>
<th>47XXY</th>
<th>46XY</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANB</td>
<td>2.1</td>
<td>2.7</td>
<td>-0.3</td>
<td>2.8</td>
</tr>
<tr>
<td>SpP/MP</td>
<td>24.9</td>
<td>21.5</td>
<td>22.3</td>
<td>20.4</td>
</tr>
</tbody>
</table>

Another observation to be made refers to the modification of posterior facial height, in the mandible size, which is a consequence of the aneuploidy of chromosome X.

All modifications produced at skull basis may be explained by the reduction of maxillary’s size by the high position of condyles, associated with flattening of the skull basis. These results agree with the hypothesis put forward by Bjork, according to which, in normal individuals, flattening of the skull basis may lead to mandibular retrognation and to vertical cranial reduction (1). To visualise the possible influence upon the modifications produced to the skull basis, the two directions (from the group affected by Turner syndrome and from the reference), were superposed on the Sellae Nasion/Sellae Basion line. Apparently, the different leanings and the prognatism of the maxillary may be partly explained by the different localization of Nasion, and by the anterior structures of the skull basis.

The data provided by profile teleradiography evidence no significant differences in cranial sizes, which confirms that, apparently, the growth of the skull is better protected against the disequilibria of the sexual chromosomes comparatively with other parts of the body. These data agree with the studies devoted to the foetal morphological cranio-facial development. Cartilaginous foetal structures, such as the foramen-clivus angle, or the SNA angle remain almost non-modified during the intrauterine period (5). An abnormal situation, such as, for example, a belated cartilaginous growth, may be a decisive factor in this process. Occurring in the prenatal period and continuing after birth by “residues” of the chondrocranium, this growth defect may be subsequently observed in the modifications of the cranio-facial morphology in Turner syndrome, which suggests that this growth disorder is probably the result of chondrodisplasy (2). Obviously, such extremely precocious modifications at skull basis cannot be compensated for by the multiple local factors which influence brain growth and development.

CONCLUSIONS

1. Skeletal modifications in genetic endocrynopathies are constantly present, at variable intensity.

2. Genetically conditioned in Turner and Klinefelter syndromes, they represent epiphenomena of the biological functions of the sexual chromosomes.
3. From this perspective, and also related to their considerable incidence (1/3000 in Turner syndrome and 1/400 in Klinefelter syndrome), the development of specific genetic and screening programs, a complex endocrinological evaluation and a complete stomatological analysis, based on a rigorously algorithmic approach for the various stages of the process, represent the only measures capable of improving any therapeutical action.

4. The frequency of skeletal disequilibria in the two clinical entities here under study calls for an interdisciplinary approach in the establishment of the most suitable therapeutical strategy.

References


