management of neonates with nonsynostotic occipital plagiocephaly has been controversial, and there has been a lack of uniformity concerning its treatment. Patients with nonsynostotic occipital plagiocephaly have been treated surgically or with cranial remodeling orthotic devices and have shown improvement in asymmetry. The cost of orthotic treatment has risen, and its validity has been contested by many third-party insurance payers. The effectiveness of orthotic treatment has not been adequately compared to the natural history of nonsynostotic occipital plagiocephaly. A nonsurgical, nonorthotic treatment study was initiated in June 1995 at Phoenix Children’s Hospital. All new patients referred with a diagnosis of nonsynostotic occipital plagiocephaly were categorized into two groups: those with mild-to-moderate asymmetry and those with moderate-to-severe asymmetry. Categories were determined by cephalic measurements. The patients with moderate-to-severe asymmetry were offered orthotic treatment with a cranial remodeling band. Those patients with mild-to-moderate asymmetry were treated with physiotherapy, repositioning of the head, and repeated notation of cephalic measurements without orthotic devices or surgery. Seventy-two neonates, seen consecutively, with mild-to-moderate, nonsynostotic occipital plagiocephaly were evaluated by noting cephalic measurements. The parents of six of these patients elected treatment with a cranial remodeling band and results in these patients were excluded from our data. The remaining 66, treated without orthotic devices, showed improvement in average cranial vault asymmetry (CVA) from 9.2 to 4.7 mm over an average treatment period of 4.5 months that commenced when the average age of the patient was 6.4 months. A comparison of the present data with data published in 1994 for neonates treated with a headband indicates that neonates with mild-to-moderate asymmetry who are treated aggressively with physiotherapy and repositioning have similar improvement in CVA.

Key Words • plagiocephaly • synostosis • torticollis • headband

The frequency of neonates presenting with nonsynostotic occipital plagiocephaly has increased in most pediatric neurosurgical practices because of recommendations from the American Association of Pediatrics indicating the superiority of the supine position in preventing sudden infant death syndrome. Controversy exists regarding occipital plagiocephaly.2,3,8,9 Plagiocephaly may result from either unilateral coronal or lambdoid synostosis. When it results from coronal synostosis, the occipital deformity is secondary and minimal, seldom requiring any treatment after correction of the frontoorbital deformity. Synostosis of the lambdoid suture is rare indeed. I have performed only two such operations in the past 9 years in more than 100 craniofacial surgeries for synostosis. Surgical treatment for occipital plagiocephaly has continued to be contested, although it is currently used in many centers in the United States.

Occipital plagiocephaly occurs most frequently because of positional deformity, either in the prenatal period or during the first few weeks after birth. At times a child may show asymmetry of the cranial arch due to positioning in the uterus or birth canal.6 These neonates usually have an associated torticollis evidenced by preference in head turning to one side and/or head tilt to one side. A few of these children may also display a “windswept” appearance of the cranial vault to one side in addition to occipital flattening and cranial vault asymmetry (CVA). This initial plagiocephalic deformity is then worsened by gravitational forces as the child continues to rest the head on the flat side. The cranium itself tends to roll to the flat side, much like a ball that is flat on one side and always comes to rest on its flat surface. Children may develop occipital flattening after birth by repeated positioning on the same side of the occiput. This seems to be the most prevalent cause. Secondary deformity of the cranial vault then follows, which results in asymmetry of the face and ear position. This secondary deformity results from the same changes in shape to a parallelogram as it leans to one side (Fig. 1).

The diagnosis of synostosis can be excluded by examination using skull radiographs or computerized tomography (CT) scans.1,4 One must be cautious to avoid diagnosing synostosis on the basis of sclerotic margins of the lambdoid suture. When the occiput is flattened due to positional plagiocephaly, the lambdoid suture is no longer visible on radiographs, giving the appearance of a synostosis. This is a common misdiagnosis of plagiocephaly due to the absence of the lambdoid suture on frontal radiographs.
bowed outward and at times can become flattened or indented. This may change the bone growth activity or its appearance on each side of the suture, resulting in the increased radiographic density seen along the suture, in spite of a visibly open suture line. This change may also reflect attempts at premature closure of the suture caused by the plagiocephalic deformity. Whatever the cause, we have seen no difference in the response to nonsurgical treatment in patients with sclerotic lambdoid suture margins compared with those without this radiographic finding.

Clinical Material and Methods

Beginning in June 1995, all children newly referred for treatment of plagiocephaly were evaluated by using skull radiography or CT scanning to exclude synostosis. Children with synostosis were treated surgically; the type of correction depended on the kind of synostosis encountered. No incidence of lambdoid synostosis was found and no surgery was performed to correct occipital plagiocephaly. Perinatal histories were obtained to ascertain any prenatal positioning that may have been noted on prenatal examinations. Positioning of the neonate following delivery as well as a history of torticollis were also noted. Cervical spine radiographs were obtained in cases displaying significant torticollis. No vertebral deformity was found in any patient.

Children referred for occipital plagiocephaly were evaluated using cephalic measurements to indicate overall CVA as well as facial asymmetry represented by anterior cranial vault measurements (Fig. 2). These measurements are a subset of the measurements obtained during studies of outcomes for patients treated with cranial remodeling headbands.\(^*\) The children were categorized into two groups: those whose measurements were 12 mm or less were designated as having mild-to-moderate asymmetry and those whose measurements were greater that 12 mm were designated as having moderate-to-severe asymmetry. Treatment with a cranial remodeling headband was offered for those children with greater than 12 mm asymmetry. Treatment with cranial remodeling headband was offered for those children with greater than 12 mm asymmetry. The parents of six of the patients with moderate-to-severe asymmetry declined treatment or were denied authorization for treatment by their third-party insurance carrier, and the children were treated with neck-stretching exercises and repositioning of the head. Of the 72 children who were designated as having mild-to-moderate asymmetry.

<table>
<thead>
<tr>
<th>Factor</th>
<th>1994 Head-band Study</th>
<th>Current Non-orthotic Study*</th>
</tr>
</thead>
<tbody>
<tr>
<td>no. of patients studied</td>
<td>46.0</td>
<td>66.0 (72)</td>
</tr>
<tr>
<td>average age at presentation (mos)</td>
<td>5.9</td>
<td>6.4 (6.6)</td>
</tr>
<tr>
<td>length of observation (mos)</td>
<td>4.3</td>
<td>4.5 (4.8)</td>
</tr>
<tr>
<td>initial asymmetry (mm)</td>
<td>8.9</td>
<td>9.2 (10.6)</td>
</tr>
<tr>
<td>ending asymmetry (mm)</td>
<td>4.0</td>
<td>4.7 (5.5)</td>
</tr>
</tbody>
</table>

* Values provided parenthetically represent all patients treated by non-orthotic management, including six patients classified as having moderate-to-severe CVA (> 12 mm).

Fig. 1. Illustration showing CVA due to gravitational forces. The image on the left represents a water-filled balloon placed on a flat surface. The bottom becomes flat, as does the top to a lesser degree, and the sides bulge outward. The image on the right shows the same effects on the cranium of a neonate, which results in asymmetry of the face and ear position. Note the parallelogram-like changes.
metry, six were treated with a headband and were excluded from data analysis. One patient did not show improvement and was subsequently treated with a headband. Data obtained in that patient are included up to the point at which the headband was applied. Table 1 shows data from our prior publication on headband treatment compared with data obtained in patients in the current study with mild-to-moderate asymmetry who were treated by nonorthotic means. The demographics from six patients in the moderate-to-severe category treated by nonorthotic means have been added to the data and are shown in parentheses in Table 1.

Parents were encouraged to engage their children in neck-stretching exercises frequently during the day and to place the child half supine with a towel or blanket roll behind the shoulder to position the occiput away from the flat side. The room was arranged and the child placed to require the head to turn away from the flat side to see parents and others in the room. Parental training included having parents perform neck-stretching exercises and head positioning in the office to assure that they would be comfortable with the treatment and that compliance would increase.

Patients were followed until both the physician and the family were comfortable with the results and were confident that the improvement would continue. This generally entailed the children being able to roll over, sit, crawl, or stand, thus spending minimal time on their backs.

Results

Seventy-two patients were followed for an average of 4.8 months and measured at 6-week to 2-month intervals. Six of these patients were classified as having moderate-to-severe asymmetry. Sixty-six of the patients were classified as having mild-to-moderate asymmetry and were followed for an average of 4.5 months. The average age of these patients at presentation and first cranial measurement was 6.4 months; the average age at completion of observation was 10.9 months. The average initial asymmetry of the cranial vault measured 9.2 mm (range 4–12 mm). The mean measurement at the end of follow up was 4.7 mm (range 1–10 mm). One patient worsened from 5 to 6 mm and was treated with a cranial remodeling band. It is of interest to note that following the headband treatment, the asymmetry remained at 5 mm in that patient after 4 months of treatment.

These results were compared with those published in 1994 in the same clinic setting and are shown in Table 1.

Data on anterior CVA are shown in Table 2. The measurement used for anterior cranial base asymmetry in our 1994 report was the distance from the superior nasion to the tragus, whereas the measurements in this current study are cross-diagonal measurements from the frontozygomatic point to the opposite tragus as shown in Fig. 2. It is of interest to note that following the headband treatment, the asymmetry remained at 5 mm in that patient after 4 months of treatment.

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Discussion

Occipital symmetry has been restored by surgical re-construction in occipital plagiocephaly thought to be due to synostosis of the lambdoid suture. External orthotic treatment has been effective in improving asymmetry in nonsynostotic occipital plagiocephaly.

The results of this study help to identify the outcomes of nonsurgical, nonorthotic intervention in benign positional or gravitational molding of the neonatal head. It
is likely that nonsynostotic occipital plagiocephaly has existed throughout the centuries. It is seen somewhat more frequently now that we have focused our attention on the matter and because more children are maintained supine for longer periods of time at early ages because of recent recommendations for preventing sudden infant death syndrome. One needs only to examine the heads in the adult population to realize that the number with appreciable asymmetry is far less in this age range than in the neonatal population. One could deduce that the natural remodeling process of the human head must correct for many of the deformities seen in childhood. Repositioning has been shown to be effective in restoring symmetry to the cranium.

The cost of treatment using external orthotic devices has risen significantly in recent years. The current cost rivals that of some neurosurgical procedures such as the common ventriculoperitoneal shunt revision. Third-party insurance payers are skeptical about the value of these devices and are reluctant at times to reimburse for them. Neurosurgeons are also becoming more cost conscious and cautious about how they choose to spend neurosurgical resources.

The results obtained in this study suggest that repositioning neonates with nonorthotic occipital plagiocephaly may produce improvement in CVA similar to that reported with external orthotic or surgical treatment. Continued vigilance is necessary to identify the patients who may not improve with repositioning and stretching exercises; rather, these patients may benefit from orthotic treatment. Further studies are needed to identify the outcomes in patients in the moderate-to-severe category who have CVA measuring greater than 12 mm. Prospective randomized studies would most likely provide more comparable and accurate results. Implementation of these studies should involve nonpartisan observers.

References


Manuscript received March 20, 1997. Accepted in final form May 28, 1997. Address reprint requests to: S. David Moss, M.D., Phoenix Children’s Hospital, 909 East Brill Street, Phoenix, Arizona 83006.