Neurodevelopmental Prognostic Factors in 73 Neonates with the Birth Head Injury

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Objective: The objective of this study was to reinterpret the neurodevelopmental prognostic factors that are associated with birth head injury by performing a long-term follow-up.

Methods: Seventy-three neonates with head injuries were retrospectively analyzed after a duration of 10.0 ± 7.3 years to determine the correlations between perinatal factors, including gender, head circumference, gestational age, body weight, and mode of delivery, and head injury factors from radiologic imaging with social, fine motor, language, and motor developmental quotients.

Results: There was a statistically significant difference between perinatal factors and head injury factors with respect to head circumference, body weight, gestational age, mode of delivery, Apgar scores at 1 min, cephalohematoma, subdural hemorrhage, subarachnoid hemorrhage, and hypoxic injury, but no direct correlation by regression analysis was observed between perinatal factors and developmental quotients. Of the head injury factors, falx hemorrhage showed a significant indirect relationship with the language and motor developmental quotients. Mode of delivery, subgaleal hematoma, cephalohematoma, greenstick skull fracture, epidural hemorrhage (EDH), tentorial hemorrhage, brain swelling, and hypoxic injury showed an indirect relationship with social development.

Conclusion: In terms of perinatal factors and head injury factors, mode of delivery, subgaleal hematoma, cephalohematoma, greenstick skull fracture, EDH, tentorial hemorrhage, falx hemorrhage, brain swelling, and hypoxic injury displayed an indirect relationship with long-term development, and therefore these factors require particular attention for perinatal care.

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Therefore, it is deemed that there is necessity for statistical investigation into the long-term neurodevelopmental prognostic factors such as perinatal factors and birth head injury factors.

The authors of the current study ascertained the relationship between perinatal factors and birth head injury factors among birth head injury neonates, and compared the long-term follow-up outcomes of developmental quotients which may lead to a reinterpretation of neurodevelopmental prognostic factors.

**Materials and Methods**

**Study design**

We included 73 infants who were born at the Ajou University Hospital and who were diagnosed with cephalohematoma, subgaleal hematoma, large cranium, and an Apgar score of less than 6 by CT or MRI for a period of 12 months from July 1, 2006 to June 31, 2007 for this study. We excluded those birth head injuries neonates with congenital anomalies, and hemophilic disorders from study. A retrospective study of the above neonates with regard to perinatal factors and cranial injury factors, and post-birth development assessment by the Denver test was performed.

**Patient data**

Perinatal factors included gender, head circumference, gestational age, body weight, mode of delivery, Apgar score at 1 minute, Apgar score at 5 minutes, frontal horn ratio and frontal-parietal width ratio. Among the 73 neonates there were 41 boys and 32 girls. The mean head circumference was 58.3 ± 37.9 percentile, mean gestational age 38.4 ± 2.4 weeks, mode of delivery was vaginal delivery in 49, Cesarean section in 22, and vacuum delivery in 2. The mean body weight was 3034 ± 575 g, and the Apgar score at 1 minute was 7.1 ± 1.8, and at 5 minutes 8.1 ± 1.7.

Head injury factors which included cephalohematoma, subgaleal hematoma, linear skull fracture, depressed skull fracture, greenstick skull fracture, epidural hemorrhage (EDH), subarachnoid hemorrhage, tentorial hemorrhage, falk hemorrhage, intracerebral hemorrhage, intraventricular hemorrhage, brain swelling, hypoxic injury were assessed by CT and MRI. Greenstick skull fracture analysis was according to the definitions and classification of Cho et al. Among the 73 neonates, the numbers of patients with linear skull fracture, depressed skull fracture, greenstick skull fracture were assessed. In those neonates with cephalohematoma, subgaleal hematoma, EDH, subarachnoid hemorrhage, tentorial hemorrhage, falk hemorrhage, hypoxic injury, lesions less than 0.5 cm were defined as Grade 0, lesions 0.5 to 1.0 cm as Grade 1, lesions 1.0 to 1.5 cm as Grade 2, and lesions greater than 1.5 cm as Grade 3. The presence of intracerebral hemorrhage or intraventricular hemorrhage that was less than 5 mL was defined as Grade 0, more than 5 mL as Grade 1, 5 to 10 mL as Grade 2, and greater than 10 mL as Grade 3. When the distance of the cranial suture distance in brain swelling was less than 0.5 cm it was defined as Grade 0, 0.5 to 1.0 cm as Grade 1, 1.0 to 1.5 cm as Grade 2, and greater than 1.5 cm as Grade 3. The frequency of head injury factors are shown in Table 1.

Follow-up developmental examinations were performed by the Denver test at the outpatient clinic visit, and consisted of social, fine motor, language, and motor functions which were compared with the normal developmental age that were calculated for relative developmental quotients as the percentage. The mean values for social, fine motor, language, and motor relative developmental quotients were 685 ± 0.273, 0.716 ± 0.255, 0.623 ± 0.260, 0.709 ± 0.247, respectively, the mean follow-up period was 10.0 ± 7.3 years, and the ratio of developmental delay that was less than 0.7 was 34.2%, 41.1%, 57.5%, and 37.5%, respectively.

**Statistical analysis**

Statistical analyses were performed using a Logistic regression correlation, χ² Fisher’s exact test, and p-values were calculated. Apgar scores less than 7 were considered to be abnormal. When the social, fine motor, language, and motor relative developmental quotients less than 0.6, 0.7, and 1.0 were defined as abnormal and delayed, correlation analysis showed no statistical difference between cut off values of 0.6, 0.7, and 1.0, and we only displayed the cut off value

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**TABLE 1. Frequency of head injury factors in 73 neonates**

| Head injuries                  | Lesion (%) |
|-------------------------------|------------|
| Cephalohematoma               | 26 (35.6)  |
| Subgaleal hematoma             | 19 (26.0)  |
| Linear skull fracture         | 2 (2.7)    |
| Depressed fracture            | 4 (5.5)    |
| Greenstick fracture           | 41 (56.2)  |
| Epidural hemorrhage           | 4 (5.5)    |
| Subdural hemorrhage            | 17 (23.3)  |
| Subarachnoid hemorrhage        | 8 (11.0)   |
| Tentorial hemorrhage           | 36 (49.3)  |
| Falx hemorrhage               | 27 (37.0)  |
| Intracerebral hemorrhage       | 4 (5.5)    |
| Intraventricular hemorrhage    | 2 (2.7)    |
| Brain swelling                | 47 (64.4)  |
| Hypoxic injury                | 35 (47.9)  |

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of relative developmental quotients 0.7.

Results

Correlation of perinatal factors and birth head injuries

Logistic regression correlation among the perinatal factors including gender, head circumference, gestational age, body weight, mode of delivery, did not show statistical significant relationship with 1 minute Apgar scores, nor with the 5 minute Apgar scores. However, the $\chi^2$ analyses of 1 minute Apgar scores demonstrated that there was statistically significant difference when perinatal and head injury factors were used as independent variables.

**TABLE 2. Logistic regression correlations of perinatal factors with head injury factors**

| Head injury factors         | Perinatal factors | Estimate* | se  | p-value | OR (95% CI) |
|----------------------------|-------------------|-----------|-----|---------|-------------|
| Cephalohematoma            | Gestational age   | 0.1271    | 0.1079 | 0.239 | 1.133 (0.919–1.403) |
|                            | Head circumference | 0.0108    | 0.0068 | 0.115 | 1.010 (0.997–1.025) |
|                            | Body weight       | 0.0004    | 0.0004 | 0.282 | 1.000 (1.000–1.001) |
| Subgaleal hematoma         | Gestational age   | -0.0322   | 0.1081 | 0.766 | 0.968 (0.783–1.197) |
|                            | Head circumference | 0.005     | 0.0072 | 0.486 | 1.005 (0.991–1.019) |
|                            | Body weight       | 0.0002    | 0.0004 | 0.604 | 1.000 (0.999–1.001) |
| Linear fracture            | Gestational age   | 0.066     | 0.316  | 0.832 | 1.069 (0.575–1.987) |
|                            | Head circumference | 0.0338    | 0.058  | 0.357 | 1.055 (0.941–1.183) |
|                            | Body weight       | -0.0004   | 0.0012 | 0.708 | 0.999 (0.997–1.002) |
| Depressed fracture         | Gestational age   | 0.460     | 0.347  | 0.185 | 1.584 (0.802–3.128) |
|                            | Head circumference | 0.005     | 0.014  | 0.727 | 1.005 (0.977–1.033) |
|                            | Body weight       | 0.001     | 0.001  | 0.388 | 1.001 (0.999–1.003) |
| Greenstick fracture        | Gestational age   | 0.146     | 0.100  | 0.145 | 1.069 (0.951–1.408) |
|                            | Head circumference | 0.008     | 0.006  | 0.228 | 1.008 (0.995–1.020) |
|                            | Body weight       | 0.000     | 0.000  | 0.321 | 1.001 (1.000–1.001) |
| Epidural hemorrhage        | Gestational age   | 0.448     | 0.343  | 0.192 | 1.565 (0.779–3.066) |
|                            | Head circumference | 0.0022    | 0.0138 | 0.873 | 1.002 (0.975–1.030) |
|                            | Body weight       | 0.00168   | 0.0011 | 0.128 | 1.002 (1.000–1.004) |
| Subdural hemorrhage        | Gestational age   | 0.0977    | 0.1222 | 0.424 | 1.103 (0.868–1.401) |
|                            | Head circumference | 0.0178    | 0.0087 | 0.041 | 1.018 (1.001–1.036) |
|                            | Body weight       | 0.0007    | 0.0005 | 0.149 | 1.001 (1.000–1.002) |
| Subarachnoid hemorrhage    | Gestational age   | -0.1924   | 0.1405 | 0.171 | 0.824 (0.626–1.087) |
|                            | Head circumference | -0.0046   | 0.0098 | 0.635 | 0.995 (0.976–1.015) |
|                            | Body weight       | -0.0014   | 0.0006 | 0.032 | 0.998 (0.997–1.000) |
| Tentorial hemorrhage       | Gestational age   | 0.0638    | 0.0972 | 0.511 | 1.065 (0.881–1.290) |
|                            | Head circumference | 0.0019    | 0.0062 | 0.757 | 1.002 (0.990–1.014) |
|                            | Body weight       | -0.0003   | 0.0004 | 0.433 | 0.999 (0.999–1.000) |
| Falx hemorrhage            | Gestational age   | 0.0837    | 0.1035 | 0.418 | 1.087 (0.888–1.332) |
|                            | Head circumference | 0.0112    | 0.0068 | 0.098 | 1.011 (0.998–1.025) |
|                            | Body weight       | -0.0002   | 0.0004 | 0.537 | 0.999 (0.999–1.001) |
| Intracerebral hemorrhage   | Gestational age   | 0.0341    | 0.2185 | 0.876 | 1.034 (0.674–1.588) |
|                            | Head circumference | 0.0025    | 0.0139 | 0.852 | 1.002 (0.976–1.030) |
|                            | Body weight       | -0.0011   | 0.0008 | 0.184 | 0.998 (0.997–1.001) |
| Intraventricular hemorrhage| Gestational age   | -0.2352   | 0.2517 | 0.350 | 0.790 (0.483–1.295) |
|                            | Head circumference | -0.0236   | 0.0222 | 0.287 | 0.976 (0.935–1.020) |
|                            | Body weight       | -0.0029   | 0.0016 | 0.071 | 0.997 (0.994–1.000) |
| Brain swelling             | Gestational age   | 0.119     | 0.1002 | 0.235 | 1.126 (0.926–1.371) |
|                            | Head circumference | -0.0028   | 0.0065 | 0.663 | 0.997 (0.984–1.010) |
|                            | Body weight       | 0.0002    | 0.0004 | 0.630 | 1.0002 (0.999–1.001) |
| Hypoxic injury             | Gestational age   | -0.434    | 0.1306 | 0.001 | 0.647 (0.502–0.837) |
|                            | Head circumference | -0.0216   | 0.00696 | 0.002 | 0.978 (0.965–0.992) |
|                            | Body weight       | -0.0011   | 0.0004 | 0.013 | 0.994 (0.998–1.000) |

*Regression coefficient. se: standard errors, OR: odds ratio, CI: confidence interval
factors were compared with respect to greenstick skull fracture, tentorial hemorrhage, brain swelling, and hypoxic injury. When the 5 minutes Apgar scores were analyzed by \(\chi^2\)/analysis of variance, the comparison of perinatal and head injury factors in terms of mode of delivery, brain swelling, and hypoxic injury showed significant difference.

There was also significant logistic regression correlation difference between perinatal factors and head injury factors with respect to subdural hemorrhage and head circumference, subarachnoid hemorrhage and body weight, hypoxic injury and gestational age, hypoxic injury and head circumference, and hypoxic injury and body weight (Table 2).

**Table 3. Logistic regression correlations of perinatal factors with 4 developmental quotients**

| Developmental quotients | Perinatal factors | Estimate* | se  | p-value | OR (95% CI) |
|-------------------------|-------------------|-----------|-----|---------|-------------|
| Social                  | Sex               | 1.743     | 1.145 | 0.127   | 5.714 (0.606–53.904) |
|                         | Mode of delivery   | -0.725    | 1.09  | 0.506   | 0.484 (0.057–4.100)  |
|                         | Gestational age    | -0.043    | 0.183 | 0.812   | 0.957 (0.668–1.371)  |
|                         | Head circumference | 0.004     | 0.013 | 0.737   | 1.004 (0.980–1.030)  |
|                         | Body weight        | -0.000    | 0.000 | 0.548   | 0.999 (0.998–1.001)  |
| Fine motor              | Sex               | -0.182    | 0.693 | 0.793   | 0.833 (0.214–3.244)  |
|                         | Mode of delivery   | -0.242    | 0.676 | 0.720   | 0.784 (0.208–2.958)  |
|                         | Gestational age    | 0.077     | 0.149 | 0.606   | 1.080 (0.806–1.448)  |
|                         | Head circumference | 0.005     | 0.009 | 0.566   | 1.005 (0.987–1.024)  |
|                         | Body weight        | 0.000     | 0.000 | 0.542   | 1.000 (0.999–1.002)  |
| Language                | Sex               | 1.42      | 1.18  | 0.228   | 4.137 (0.410–41.796) |
|                         | Mode of delivery   | -0.449    | 1.105 | 0.684   | 0.638 (0.073–5.567)  |
|                         | Gestational age    | 0.165     | 0.252 | 0.511   | 1.179 (0.720–1.934)  |
|                         | Head circumference | 0.001     | 0.013 | 0.938   | 1.001 (0.974–1.028)  |
|                         | Body weight        | 0.000     | 0.000 | 0.528   | 1.000 (0.999–1.003)  |
| Motor                   | Sex               | 0.852     | 0.772 | 0.270   | 2.345 (0.516–10.662) |
|                         | Mode of delivery   | 0.073     | 0.691 | 0.915   | 1.075 (0.278–4.170)  |
|                         | Gestational age    | 0.038     | 0.159 | 0.808   | 1.039 (0.761–1.420)  |
|                         | Head circumference | -0.008    | 0.009 | 0.414   | 0.991 (0.973–1.011)  |
|                         | Body weight        | 0.000     | 0.001 | 0.847   | 1.000 (0.999–1.001)  |

*Regression coefficient, se: standard errors, OR: odds ratio, CI: confidence interval

**Table 4. Fisher’s exact test for correlations of head injury factors with developmental quotients**

| Head injury factors | p-values on developmental quotients |
|---------------------|------------------------------------|
|                     | Social | Fine motor | Language | Motor |
| Cephalohematoma      | 1.000  | 1.000      | 0.290    | 0.703 |
| Subgaleal hematoma   | 0.316  | 0.437      | 0.567    | 1.000 |
| Linear fracture      | 1.000  | 1.000      | 1.000    | 1.000 |
| Depressed fracture   | 1.000  | 0.641      | 0.206    | 1.000 |
| Greenstick fracture  | 1.000  | 1.000      | 0.626    | 0.453 |
| Epidural hemorrhage  | 1.000  | 1.000      | 1.000    | 1.000 |
| Subdural hemorrhage  | 1.000  | 0.435      | 1.000    | 0.672 |
| Subarachnoid hemorrhage | 1.000 | 1.000      | 1.000    | 0.586 |
| Tentorial hemorrhage | 1.000  | 0.085      | 1.000    | 0.056 |
| Falx hemorrhage      | 1.000  | 0.080      | 0.033    | 0.023 |
| Intracerebral hemorrhage | 0.252 | 1.000      | 1.000    | 0.378 |
| Intraventricular hemorrhage | 0.133 | 1.000      | 1.000    | 1.000 |
| Brain swelling       | 0.649  | 0.737      | 1.000    | 0.703 |
| Hypoxic injury       | 1.000  | 0.738      | 0.616    | 0.713 |
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weight, mode of delivery, with social, fine motor, language, motor developmental delay (Table 3). Fisher’s exact test of head injury factors such as social, fine motor, language, and motor development demonstrated significant relationship with falx hemorrhage and language development, and falx hemorrhage and motor development (Table 4). When the 4 developmental quotients were compared by $\chi^2$ for perinatal factors and head injury factors, mode of delivery, subgaleal hematoma, cephalohematoma, greenstick skull fracture, EDH, tentorial hemorrhage, brain swelling, and hypoxic injury were significant factors for social development. Fine motor and motor development was only significant in hypoxic injury, while language development was nor significant in any fields (Table 5).

**Discussion**

Correlation of perinatal factors and birth head injuries

It has been shown in previous studies among the perinatal factors - mode of delivery, time of birth, low Apgar score at 5 minutes, gestational age at birth are associated with the neonatal death rate. Proposed predictors of birth trauma has been suggested to decreased fetal heart rate, shoulder dystocia, male gender, neonatal weight, neonatal head circumference, prolonged gestation, macrosomia, low Apgar scores, delivery during risk hours, instrumental delivery, fundal pressure, vaginal delivery, delivery by resident, induction of labor, second stage labor exceeding 60 minutes, epidural anesthesia, parity, and maternal age and delivery in a teaching hospital. In contrast, maternal age, ethnicity, diabetes, and operative vaginal delivery have not been related to birth trauma.

According to the results of our current research, the correlation analysis between perinatal factors and head injury factors and Apgar scores showed statistical relationships of Apgar scores with mode of delivery, greenstick skull fracture, tentorial hemorrhage, brain swelling, or hypoxic injury. In addition, the statistical analysis between perinatal factors and head injury factors revealed that head circumference, body weight, gestational age, and mode of delivery were associated with perinatal factors such as subdural hemorrhage, subarachnoid hemorrhage, hypoxic injury, and cephalohematoma. Therefore, while there is no direct relationship between most perinatal factors and Apgar scores, it is postulated that there may be an indirect association between Apgar scores and perinatal factors because relationships exist between perinatal factors and Apgar scores and between many head injury factors and Apgar scores.

It has been suggested in many previous researches that a large fetal head will result in increased compression during passage through the birth canal, subsequently leading to more frequent head injuries. Likewise, our observation in the present study shows that increase of the head circumference by 1 cm will increase subdural hemorrhage by 1.018 fold, increase of newborn body weight by 1 kg will worsen subarachnoid hemorrhage by 0.9985 fold, longer gestation age by 1 week and increase of head circumference by 1 cm and increase of newborn body weight by 1 kg resulted in increased hypoxic injury by 0.65, 0.98, and 0.99 fold, respectively. It is therefore envisaged that newborn head size governing perinatal factors such as gestational age, body weight, head circumference all contribute partially to birth head injuries of newborns.

**Correlation of perinatal factors and birth head injuries with developmental quotients**

Perinatal factors or injury such as low birth weight, reduced head circumference, incubator, hypoxic-ischemic brain injury or intraventricular hemorrhage not only increases neonatal mortality rates but also may attribute to severe neurological impairment including cerebral palsy, seizures, mental retardation, and learning disabilities, or may be related to mental diseases such as ADHD, autism, and schizophrenia in the long-term period.
Among the 4 development fields, social development showed significant differences in many perinatal factors and head injury factors and motor and language development showed difference only in the falx hemorrhage factor, while fine motor did not show such difference over any factors. Therefore, detailed caution should be given to birth injuries such as mode of delivery, subgaleal hematoma, cephalohematoma, greenstick skull fracture, EDH, tentorial hemorrhage, falx hemorrhage, brain swelling, and hypoxic injury as long-term development differences may arise. Access from other perspectives are envisaged to be necessary pertaining to social development.

Conclusion

The perinatal and cranial injury factors including mode of delivery, subgaleal hematoma, cephalohematoma, greenstick skull fracture, EDH, tentorial hemorrhage, falx hemorrhage, brain swelling, hydrocephalus, and hypoxic injury showed indirect relationship with long-term development in this study. Therefore, particular attention requires especially these perinatal and head injury factors in perinatal care.

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REFERENCES

1) Abedzadeh-Kalahroudi M, Talebian A, Jahangiri M, Mesdaghinia E, Mohammadzadeh M. Incidence of neonatal birth injuries and related factors in Kashan, Iran. Arch Trauma Res 4:e22831, 2015
2) Badr LK, Bookheimer S, Purdy I, Deeb M. Predictors of neuro-developmental outcome for preterm infants with brain injury: MRI, medical and environmental factors. Early Hum Dev 85:279-284, 2009
3) Badr LK, Garg M, Kamath M. Intervention for infants with brain injury: results of a randomized controlled study. Infant Behav Dev 29:80-90, 2006
4) Boksa P, El-Khodor BF. Birth insult interacts with stress at adulthood to alter dopaminergic function in animal models: possible implications for schizophrenia and other disorders. Neurosci Biobehav Rev 27:91-101, 2003
5) Cannon M, Jones PB, Murray RM. Obstetric complications and schizophrenia: historical and meta-analytic review. Am J Psychiatry 159:1080-1092, 2002
6) Chadwick LM, Pemberton PJ, Kurinczuk JJ. Neonatal subgaleal haematoma: associated risk factors, complications and outcome. J Paediatr Child Health 32:228-232, 1996
7) Cho SM, Kim HG, Yoon SH, Chang KH, Park MS, Park YH, et al. Reappraisal of neonatal greenstick skull fractures caused by birth injuries: Comparison of 3-dimensional reconstructed computed tomography and simple skull radiographs. World Neurosurg 109: e365-e312, 2018
8) Gardener H, Spiegelman D, Buka SL. Perinatal and neonatal risk factors for autism: a comprehensive meta-analysis. Pediatrics 128:344-355, 2011
9) Iliodromiti S, Mackay DF, Smith GC, Pell JP, Nelson SM. Apgar score and the risk of cause-specific infant mortality: a population-based cohort study. Lancet 384:1749-1755, 2014
10) Kilani RA, Wetmore J. Neonatal subgaleal hematoma: presentation and outcome--radiological findings and factors associated with mortality. Am J Perinatol 23:41-48, 2006
11) Kolderup LB, Laros RK Jr, Musci TJ. Incidence of persistent birth injury in macrosomic infants: association with mode of delivery. Am J Obstet Gynecol 177:37-41, 1997
12) Leestma JE. Forensic neuropathology in Duckett S (ed): Pediatric neuropathology. Baltimore, MD: Williams & Wilkins, pp243-283, 1995
13) Levine MG, Holroyde J, Woods JR Jr, Siddiqi TA, Scott M, Miodovnik M. Birth trauma: incidence and predisposing factors. Obstet Gynecol 63:792-795, 1984
14) Linder N, Linder I, Fridman E, Kouadio F, Lubin D, Merlob P, et al. Birth trauma-risk factors and short-term neonatal outcome. J Matern Fetal Neonatal Med 26:1491-1495, 2013
15) Liu L, Johnson HL, Cousens S, Perin J, Scott S, Lawn JE, et al. Global, regional, and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. Lancet 379:2151-2161, 2012
16) Mehta SH, Blackwell SC, Bujold E, Sokol RJ. What factors are associated with neonatal injury following shoulder dystocia? J Perinatol 26:85-88, 2006
17) Milberger S, Biederman J, Faraone SV, Guite J, Tsuang MT. Pregnancy, delivery and infancy complications and attention deficit hyperactivity disorder: issues of gene-environment interaction. Biol Psychiatry 41:65-75, 1997
18) Nongena P, Ederies A, Azzopardi DV, Edwards AD. Confidence in the prediction of neurodevelopmental outcome by cranial ultrasound and MRI in preterm infants. Arch Dis Child Fetal Neonatal Ed 95:F388-F390, 2010
19) Parker LA. Part 1: early recognition and treatment of birth trauma: injuries to the head and face. Adv Neonatal Care 5:288-297, 2005