Available online at www.medicinescience.org

ORIGINAL ARTICLE

Medicine Science International Medical Journal

Medicine Science 2024;13(3):758-62

Neonatal clavicular fracture: Can induction of labor be a risk factor?

Mahli Batuhan Ozdogar[1], Cengizhan Kurt[2], Murat Ayar[1], Ozgur Olukman[3]

[1]Çiğli Training and Research Hospital, Department of Pediatrics, İzmir, Türkiye
[2]İzmir Bakırçay University, Faculty of Medicine, Department of Orthopedics and Traumatology, İzmir, Türkiye.
[3]İzmir Bakırçay University, Faculty of Medicine, Department of Pediatrics, Division of Neonatology, İzmir, Türkiye

Received 30 May 2024; Accepted 17 July 2024
Available online 01 September 2024 with doi: 10.5455/medscience.2024.05.051

Abstract

Perinatal clavicular fracture is the most common birth injury that may cause neonatal morbidities such as obstetric brachial palsy (OBP) ranging from 0.2 to 3.5%. We aimed to compare the relationship between perinatal clavicular fracture and induced vaginal delivery. All the live births and the neonatal outpatient clinic admissions between June 2016 and December 2022 have been investigated retrospectively. A total of 185 newborn infants with a mean gestational age of 38.3±1.6 weeks and a mean birth weight of 3,451±430.10 grams were enrolled. When compared to all in-born live births, the overall incidence of clavicular fracture was 0.78%. One hundred eighty-one (97.8%) infants were born vaginally and 4 (2.2%) were born by cesarean sections (C-sections). The incidence of clavicular fracture among in-born vaginally delivered infants was 1.26% (n=153) and among C-section deliveries was 0.04% (n=3). In vaginal deliveries, 54.7% (n=99) had prolonged labor, 71.8% (n=130) had received labor induction and 7.7% (n=14) had a history of instrumental intervention. A statistically significant relationship was found between clavicular fracture and prolonged labor, labor induction, increased birth weight, and low Apgar scores (p<0.001). While 21 infants (11.4%) had cephalohematoma, 8 infants (4.3%) presented with symptoms of OBP. Although high birth weight, prolonged labor, and ventouse delivery are the already known major risk factors for neonatal clavicular fractures, induced vaginal delivery has been defined as a new and important risk factor. Induction of labor should be decided when the benefits of immediate delivery outweigh the risks of continuing the pregnancy for fetal and maternal health.

Keywords: Clavicle, fracture, vaginal delivery, labor induction

Introduction

The clavicle is the bone most frequently fractured during delivery and usually occurs unilaterally [1]. Most clavicular fractures are of the greenstick type, but occasionally, the fracture is complete. The incidence of clavicle fractures due to birth trauma ranges from 0.5% to 1.6%, and the associated rate of obstetric brachial palsy (OBP) ranges from 4 to 13% in the current literature [1-5]. The most important already-known risk factors are fetal macrosomia, shoulder dystocia, prolonged and difficult labor, instrumental vaginal delivery, postmaturity, maternal diabetes, and obesity [1-6]. However, fracture of the clavicle may also occur in infants after apparently normal spontaneous labor and delivery.

Inducing uterine contractions before spontaneous labor onset to facilitate vaginal delivery, known as labor induction, has become increasingly common, typically warranted for medical or obstetric reasons [7]. However, there is a practice termed 'elective induction' where induction occurs without valid medical indications, often for logistical or psychosocial considerations [7-8]. In recent times, the global and national rates of elective labor induction have surged, leading to notable maternal and neonatal health risks. While less than two-thirds of pregnant women receiving elective labor induction give birth without further surgical intervention, 15% require instrumental delivery, and 22% undergo cesarean sections (C-sections) [9]. Initiating vaginal delivery, especially before cervical maturation, may lead the fetus to become more vulnerable to either normal forces of labor or, sometimes, abnormal overload related to uteropelvic mismatch and cause birth injuries.

In this study, we aimed to evaluate the relationship between electively induced vaginal delivery and the most frequent birth trauma, neonatal clavicular fracture.

CITATION
Ozdogar MB, Kurt C, Ayar M, Olukman O. Neonatal clavicular fracture: Can induction of labor be a risk factor?. Med Science. 2024;13(3):758-62.

Corresponding Author: Mahli Batuhan Ozdogar, Çiğli Training and Research Hospital, Department of Pediatrics, İzmir, Türkiye
Email: ozdogarbatuhan@gmail.com

DOI: 10.5455/medscience.2024.05.051

Material and Methods

This retrospective study was conducted at our hospital's Department of Pediatrics, Division of Neonatology, with approval from the Noninvasive Research Ethics Board of our university (Approval Date: 26.07.2023/Approval Number: 1134), adhering to the Declaration of Helsinki guidelines (revised in Brazil in 2013).

Hospital records of outpatient clinic admissions and live births between June 2016 and December 2022 were reviewed. Data on maternal and neonatal demographics, mode of delivery, labor induction, intrapartum risk factors (duration and difficulty level of labor, presence of any instrumentation, Apgar scores), diagnosis details (time and tool), fracture characteristics, accompanying comorbidities, and clinical outcomes of 185 neonates with clavicular fractures were analyzed. Results from 181 vaginally delivered newborns with fractures were compared to those of 200 vaginally delivered healthy-term newborns.

Data was analyzed using IBM SPSS (Version 25.0, Armonk, NY: IBM Corp.). Normal distribution was confirmed, and parametric methods were employed. Results were presented as percentages and mean (standard deviation). Paired Sample T-test and Chi-square test were utilized for continuous and categorical variables, respectively. Correlation analyses were conducted using Spearman and Pearson correlation tests. Logistic regression analysis determined the association between independent variables and specific outcomes. A significance level of $p<0.05$ was considered.

Results

The study group involved 185 newborns with clavicular fracture mean gestational age of 38.3±1.6 weeks and a mean birth weight of 3.551±430.10 grams. Fifty-three percent of infants were male, and 47% were female. The majority of the infants (75.6%) were appropriate for gestational age (AGA). While 156 deliveries had occurred in our hospital, 29 had taken place in other local city hospitals. When live birth rates of our hospital in the course of the study were considered (n=19.955, vaginal=12.112, C-section=7.843), the overall incidence of clavicular fracture was calculated to be 0.78%. In the whole study group, 181 infants (97.8%) were born vaginally, and four infants (2.2%) were born by C-section. On the other hand, in the patient group born in our hospital, 153 infants (98%) were born vaginally, and three infants (2%) were born by C-section. The incidence of clavicular fracture among in-born vaginally delivered infants was 1.26% (n=153), and among C-section deliveries was 0.04% (n=3), respectively.

Ninety-five percent (n=148) of in-born infants were diagnosed before discharge. Out-born patients were diagnosed on their first visit to our neonatal outpatient clinic. The median time of diagnosis in the whole study group was postnatal four days (min=1 day, max=27 days). The diagnosis was suspected upon detailed physical examination and history in all infants, and confirmation was made by chest X-ray. While the most frequent fracture side was the right clavicle (60%), the most frequent location, according to the Allman classification, was the mid-shaft (76.8%). A summary of the demographical features and clinical findings of infants is presented in Table 1.

Table 1. Demographical features and clinical findings of neonates with clavicular fracture (n=185)

	n (%)/ mean±SD/ median (min-max)
Place of birth	
In-born	156 (84.3)
Out-born	29 (15.7)
Gender	
Female	87 (47)
Male	98 (53)
Gestational age (weeks)	38.3±1.6
Birth weight (g)	3,551±430.10
Birth centile	
SGA	4 (2.2)
AGA	140 (75.6)
LGA	41 (22.2)
Mode of delivery	
Vaginal	181 (97.8)
C/S	4 (2.2)
Time of diagnosis (postnatal days)	4 (1-27)
Time of diagnosis for in-born infants (n=156)	
Before discharge	148 (95)
After discharge	8 (5)
Side of fracture	
Right	111 (60)
Left	72 (38.9)
Bilateral	2 (1.1)
Localization (Allman classification)	
Group 1 (mid-shaft/ middle 1/3)	142 (76.8)
Group 2 (lateral-distal 1/3)	37 (20)
Group 3 (medial-proximal 1/3)	6 (3.2)
Tool of diagnosis/ confirmation	
Exam+ history	185 (100)
X-ray	185 (100)
Comorbidities	
Obstetric brachial plexus palsy	8 (4.3)
Cephalohematoma	21 (11.4)
Complications	
Pain	139 (75.1)
Failure to breastfeed	81 (43.7)
Weight loss (over physiological limits)	76 (41.1)
Delayed catch-up of birth weight	76 (41.1)
Hyperbilirubinemia (requiring phototherapy)	89 (48.1)
Prognosis (full recovery)	185 (100)

DOI: 10.5455/medscience.2024.05.051

In our study, we compared vaginally born infants with fractures with a control group of vaginally delivered infants without fractures in terms of possible risk factors (Table 2). In vaginal deliveries with clavicular fracture, 95% (n=172) had a cephalic presentation, and 56.3% (n=102) had prolonged labor. In addition, 73.4% (n=133) had received labor induction, and 11% (n=20) had a history of intervention with a vacuum. On logistic regression analysis, prolonged labor (OR, 3.275; 95% CI: 1.096–9.781, P<0.001), labor induction (OR, 1.003; 95% CI: 1.001–1.005, P<0.001), increased birth weight (OR, 1.002; 95% CI: 1.001–1.003, P<0.001) and low Apgar scores (less than 7 points at 1 and 5 minutes) (OR, 4.178; 95% CI: 1.097–8.671, P<0.001) were found as significant risk factors for clavicular fracture.

Table 2. Comparison of vaginally born infants with and without fracture in terms of risk factors

	Vaginally born fracture group (n=181)	Vaginally born control group (n=200)	p
Maternal age (years)	28.1±5.4	28.6±4.1	0.076
Gravidity	2.2±1.2	2.0±1.1	0.369
Parity			
Primiparous, n (%)	51 (28.2)	59 (29.5)	0.431
Multiparous, n (%)	130 (71.8)	141 (70.5)	0.388
Gestational diabetes/ Impaired glucose tolerance, n (%)	28 (15.5)	25 (12.5)	0.285
Presentation			
Cephalic	172 (95)	192 (96)	0.137
Others (breech, shoulder, transverse vb)	9 (5)	8 (4)	0.091
Gestational age (weeks)	38.1±1.4	39.0±1.3	0.086
Birth weight (g)	3.538±381.10	3107.6±391.5	**0.037**
Birth weight >4000 g, n (%)	34 (18.8)	6 (3)	**<0.001**
Apgar 1´	7.1±0.7	8.4±0.9	**0.025**
Apgar 5´	8.5±0.8	9.5±0.8	**0.039**
Prolonged labor, n (%)	102 (56.3)	36 (18)	**0.032**
Instrumentation (vacuum), n (%)	20 (11)	2 (1)	**<0.001**
Elective induction, n (%)	133 (73.4)	18 (9)	**<0.001**

Fractures healed spontaneously in all infants. While 21 infants (11.4%) had cephalohematoma, eight infants (4.3%) presented with symptoms of OBP (weak and limited arm movement) but had benign outcomes without any neurological sequelae. Other complications related to fracture were pain (75.1%), failure to breastfeed (43.7%), weight loss beyond physiological limits (41.1%), delayed catch-up of birth weight (10.3±2.7 days), and hyperbilirubinemia requiring phototherapy (48.1%).

Discussion

Neonatal clavicular fractures are the most commonly reported birth trauma of the extremities, with an incidence ranging from 0.5 to 1.6% in different case series [4-6]. The exact mechanism of clavicular fracture during delivery remains to be unclear. The most probable mechanism is the compression of the fetal anterior shoulder against the maternal symphysis pubis [10-12]. Reported risk factors for clavicular fractures include operative (instrumental) delivery, prolonged and difficult labor, post-term delivery, shoulder dystocia, macrosomia (birth weight >4 kg, length >52 cm), lower mean head-to-abdominal circumference ratio, increased maternal age, maternal diabetes, and maternal obesity [4-6]. In our study, 84% of the infants were born in the maternity wards of our hospital. When the live birth rates of our hospital during the course of the study were considered (n=19.955), the overall incidence of clavicular fracture was calculated to be 0.78%, which is compatible with the current literature. When proportioned to the mode of delivery, the incidence was 1.26% in vaginal deliveries and 0.04% in C-sections. When evaluated for possible risk factors, we could not find any statistical difference in terms of gestational age, maternal age, gravidity, parity, presence of gestational diabetes, and fetal presentation between the vaginally born study and control groups. However, mean birth weight was significantly higher in the study group (p=0.037). We found that 18.8% of infants in the study group were macrosomic infants weighing >4 kg. In line with the findings of previous articles, prolonged labor and instrumental delivery were significantly higher in the study group (p=0.032 and p<0.001, respectively) [1-6].

Most clavicular fractures are greenstick and relatively recently diagnosed due to an asymptomatic course [5]. However, early detection is possible with meticulous physical examination immediately after birth, especially if the fracture is displaced. In such cases, crepitus, edema, lack of movement of the affected extremity, asymmetrical bone contour, and crying with passive

DOI: 10.5455/medscience.2024.05.051

motion are remarkable. On the other hand, even if the fracture is nondisplaced, decreased Moro reflex, tenderness, swelling, and crepitation of the affected shoulder may still be present on the first days of life [5,10]. However, the diagnosis of nondisplaced fractures is often delayed by days or weeks (mean 7-10 days) until there is a formation of a visible or palpable callous [10-12]. In our study, 95% of infants born in our hospital were diagnosed before discharge. The median time of diagnosis in the whole study group was postnatal four days (min=1 day, max=27 days). A radiographic examination confirms the diagnosis of fracture. X-ray of the chest and upper extremities enables differential diagnosis between clavicular fracture and brachial plexus injury, traumatic epiphysial separation and fracture of the humerus, and dislocations of the shoulder [10]. In our study, diagnosis was suspected both upon physical examination and obstetric history in all infants, and confirmation was made by chest X-ray. In line with previous studies in the literature [3,13], the right clavicle was fractured 1.5 times more than the left clavicle, and according to Allman classification [14], the mid-shaft fractures were observed more than 3.3 times compared to medial and lateral fractures in our study.

An association between perinatal clavicle fracture and OBP is found in 4–13% of cases [3,15]. Therefore, the presence of a clavicle fracture warrants further investigation for any possible accompanying OBP. OBP associated with neonatal clavicular fracture is mostly transient, with a total return of function in many cases. However, less than 10% may cause a permanent deficit [3,16,17]. In a recent study performed in our hospital, we demonstrated that after a 2-year follow-up of 39 infants with OBP, 24 patients recovered spontaneously, 6 had sequelae without functional impairment, 5 had sequelae with functional impairment, and 2 had contractures [18]. There are only a few reports in the current literature describing the anatomical location of neonatal clavicular fractures [14,19] and only one analyzing the possible association between the fracture location and OBP [3]. In this particular study, Casellas-Garcia et al. declared that, unlike adults, Allman group III fractures (medial third clavicle) were the most common clavicle fracture location related to the appearance of OBP [3]. In our study, we found that the most frequent fracture side was the right clavicle (60%), and the most frequent location, according to the Allman classification, was the mid-shaft position (Allman I) (76.8%). Only eight infants (4.3%) presented with weak and limited arm movements, indicating OBP, but all improved with regular physiotherapy on follow-up without developing any permanent motor or sensorial deficit.

A wide spectrum of birth injuries ranging from minor and self-limited problems to severe injuries that may result in significant neonatal morbidity or mortality (soft tissue injuries, extracranial injuries, intracranial hemorrhage, other bone fractures and dislocations, neurologic injuries, birth asphyxia, abdominal organ injuries) can accompany clavicular fractures [2]. In the present study, we did not observe any major accompanying problems, including birth asphyxia. We observed cephalohematoma in 11.4% of infants.

Clavicular fracture treatment is directed toward immobilizing the arm to minimize the infant's pain [1,2,4-6,10-13]. The arm on the affected side is usually placed in long-sleeved apparel and pinned to the chest with the elbow at 90 degrees of flexion [12]. Analgesics can also be ordered for pain relief. Parents should pay attention to gentle handling. Healing occurs with spontaneous callus formation [10-13]. The prognosis is usually favorable [1,2,4-6,10-13,15,19,20]. All infants in our study received conventional treatment methods, including immobilization, positioning, and gentle handling. Only a few patients received paracetamol to ease pain. Our study observed spontaneous, full recovery in all infants without any sequelae. However, we observed secondary complications such as pain, unsuccessful breastfeeding due to difficulty in taking a position on the mother's breast, weight loss beyond physiological limits because of unsuccessful breastfeeding, delayed catch-up of birth weight, and hyperbilirubinemia requiring phototherapy. Therefore, although the prognosis is usually favorable in the vast majority of the cases, clinicians should be aware of secondary morbidities and pay attention to breastfeeding, weight gain, dehydration, and neonatal jaundice on follow-up.

Although high birth weight, prolonged labor, and ventouse delivery are the already known major risk factors for neonatal clavicular fractures, induced vaginal delivery has been defined as a new and important risk factor in this study. Approximately 15% of pregnant women receiving elective labor induction require instrumental delivery, causing the fetus to become more vulnerable to birth injuries [9]. Therefore, induction of labor should be decided when the benefits of immediate delivery outweigh the risks of continuing the pregnancy for both the fetal and the maternal health. In recent years, the rate of elective induction of labor has risen dramatically throughout the world and our country, in fact bringing significant maternal and neonatal morbidity [9,21-27]. In our study, we determined a significant relationship between induced vaginal delivery and neonatal clavicular fracture. Although the exact mechanism of fracture is unclear, we suggest that it results from the increment of stimulation on the relatively immature cervix and the excessive effect of maternal pelvic forces on the fetus.

Conclusion

In conclusion, although the prognosis is usually favorable and healing occurs spontaneously in neonatal clavicular fractures, it may be concerning to parents and often leads to complaints regarding pain, excessive crying, and unsuccessful breastfeeding. It should be concerning to physicians because of excessive weight loss, dehydration, hyperbilirubinemia, and possible associated OBP. Fetal macrosomia, shoulder dystocia, prolonged labor, and ventouse delivery are major risk factors for the development of neonatal clavicular fractures. In the present study, we demonstrated that induced vaginal delivery is also a significant risk factor. Because of all these reasons, as mentioned

DOI: 10.5455/medscience.2024.05.051

above, we think that induction of labor in vaginal deliveries should be applied only in the presence of valid medical or obstetric indications and especially after confirming the signs of cervical maturation. It should also be considered that the study's results reflect data from more than one hospital.

Conflict of Interests
The authors declare that there is no conflict of interest in the study.

Financial Disclosure
The authors declare that they have received no financial support for the study.

Ethical Approval
This retrospective study was conducted at our hospital's Department of Pediatrics, Division of Neonatology, with approval from the Noninvasive Research Ethics Board of our university (Approval Date: 26.07.2023/Approval Number: 1134), adhering to the Declaration of Helsinki guidelines (revised in Brazil in 2013).

References

1. Nikolov A, Veleva G, Nashar S, et al. Fracture of the clavicle in newborns, an attempt to make prognostic factors. Akush Ginekol (Sofiia). 2011;50:4-7.
2. McBride MT, Hennrikus WL, Mologne TS. Newborn clavicle fractures. Orthopedics. 1998;21:317-20.
3. Casellas-Garcia G, Cavanilles-Walker JM, Alberti-Fito G. Clavicular fracture in the newborn: is fracture location a risk factor for obstetric brachial palsy?. J Neonatal Perinatal Med. 2018;11:61-4.
4. Beall MH, Ross MG. Clavicle fracture in labor: risk factors and associated morbidities. J Perinatol. 2001;21:513-5.
5. Hsu TY, Hung FC, Lu YJ, et al. Neonatal clavicular fracture: clinical analysis of incidence, predisposing factors, diagnosis, and outcome. Am J Perinatol. 2002;19:17-21.
6. Lam MH, Wong GY, Lao TT. Reappraisal of neonatal clavicular fracture: the relationship between infant size and neonatal morbidity. Obstet Gynecol. 2002;100:115-9.
7. ACOG Practice Bulletin no 107. Induction of labor. Obstet Gynecol. 2009;114:386-97.
8. Ashton DM. Elective delivery at less than 39 weeks. Curr Opin Obstet Gynecol. 2010;22:506-10.
9. National Institute for Health and Clinical Excellence (NICE) guideline. Induction of labor. https://www.nice.org.uk/guidance/ng207 access date 15.04.2024
10. Oppenheim WL, Davis A, Growdon WA, et al. Clavicle fractures in the newborn. Clin Orthop Relat Res. 1990;250:176-80.
11. Gilbert WM, Tchabo JG. Fractured clavicle in newborns. Int Surg. 1998;73:123-5.
12. Ahn ES, Jung MS, Lee YK, et al. Neonatal clavicular fracture: recent 10-year study. Pediatr Int. 2015;57:60-3.
13. Balata A, Olzai MG, Porcu A, et al. Clavicular fractures in the newborn infant. Pediatr Med Chir. 1984;6:125-9.
14. Allman FL Jr. Fractures and ligamentous injuries of the clavicle and its articulation. J Bone Joint Surg (Am). 1967;49:774-84.
15. Kaplan B, Rabinerson D, Avrech OM, et al. Fracture of the clavicle in the newborn following normal labor and delivery. Int J Gynaecol Obstet. 1998;63:15-20.
16. Perlow JH, Wigton T, Hart J, et al. Birth trauma. A five-year review of incidence and associated perinatal factors. J Reprod Med. 1996;41:754-60.
17. Peleg D, Hasnin J, Shalev E. Fractured clavicle and Erb's palsy unrelated to birth trauma. Am J Obstet Gynecol. 1997;177:1038-40.
18. Tekin HG, Olukman O. Long-term outcome in obstetric brachial plexus injury at a tertiary care center. J Surg Med. 2022;6:5-8.
19. Sauber-Schatz EK, Markovic N, Weiss HB, et al. Descriptive epidemiology of birth trauma in the United States in 2003. Paediatr Perinat Epidemiol. 2010;24:116-24.
20. Gupta R, Cabacungan ET. Neonatal birth trauma: analysis of yearly trends, risk factors, and outcomes. J Pediatr. 2021;238:174-180.e3.
21. Yeast JD, Jones A, Poskin M. Induction of labor and the relationship to cesarean delivery: a review of 700 consecutive inductions. Am J Obstet Gynecol. 1999;180:628-33.
22. Battista L, Chung JH, Lagrew DC, Wing DA. Complications of labor induction among multiparous women in a community-based hospital system. Am J Obstet Gynecol. 2007;197:241.e1-e4.
23. Guerra GV, Cecatti JG, Souza JP, et al. Elective induction versus spontaneous labor in Latin America. Bull World Health Organ. 2011;89:657-65.
24. Vardo JH, Thornburg LL, Glantz JC. Maternal and neonatal morbidity among nulliparous women undergoing elective induction of labor. J Reprod Med. 2011;56:25-30.
25. Cammu H, Martens G, Ruyssinck G, Amy JJ. Outcome after elective labor induction in nulliparous women: a matched cohort study. Am J Obstet Gynecol. 2002;186:240-4.
26. Crane JM. Factors predicting labor induction success: a critical analysis. Clin Obstet Gynecol. 2006;49:573-84.
27. Çetinkaya ŞE, Söylemez F. Factors affecting the success of birth and birth induction methods. Ankara Üniversitesi Tıp Fakültesi Mecmuası. 2013;66:25-32.