

Research Article

A Ten-Year Analysis of Maternal and Obstetric Risk Factors in Neonatal Clavicle Fractures

 Seniye Burcu Torumtay Aliç,¹  Taner Aliç,²  İsmail Kürşad Gökçe³

¹Department of Gynecology and Obstetrics, Hitit University Faculty of Medicine, Çorum, Türkiye

²Department of Orthopaedics and Traumatology, Hitit University Faculty of Medicine, Çorum, Türkiye

³Department of Pediatrics, Hitit University Faculty of Medicine, Çorum, Türkiye

Abstract

Objectives: The aim of this study was to evaluate birth-related neonatal clavicle fractures over a ten-year period and to analyze maternal, fetal, and obstetric risk factors within the framework of the Robson classification system.

Methods: This retrospective, single-center, observational study included neonates diagnosed with clavicle fractures among live births occurring between January 1, 2015, and December 31, 2025, at a tertiary referral hospital. Maternal age, parity, mode of delivery, labor characteristics, fetal presentation, birth weight, Robson classification group, presence of associated brachial plexus injury, and clinical management processes were reviewed. Data were obtained from hospital medical records and analyzed using descriptive and univariate statistical methods.

Results: During the study period, 136 neonates with clavicle fractures were identified among 33,722 live births, yielding an incidence of 4.0 per 1,000 live births. The majority of fractures occurred following vaginal delivery (97.1%). Clavicle fractures were most frequently observed in low-risk obstetric categories, particularly Robson Group 1 (46.3%) and Group 3 (48.5%). The mean gestational age was 38.6 weeks, and the mean birth weight was 3585 g. Brachial plexus injury accompanied clavicle fractures in 2.9% of cases and showed a tendency to be associated with higher birth weight and operative vaginal delivery, although statistical significance was not reached. All cases were diagnosed through physical examination and confirmed by radiographic imaging. Conservative management was sufficient in all neonates, and no surgical intervention was required.

Conclusion: Neonatal clavicle fractures are not limited to high-risk pregnancies and frequently occur after routine vaginal deliveries in low-risk Robson groups. Early diagnosis and a multidisciplinary conservative approach provide favorable clinical outcomes.

Keywords: Birth Trauma, Brachial Plexus Injury, Neonatal Clavicle Fracture, Neonatal Intensive Care Unit, Vaginal Delivery

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Birth-related fractures observed during the neonatal period remain a clinically relevant problem despite significant advances in obstetric and neonatal care.^[1] Among these injuries, clavicle fractures are the most frequently reported form of birth trauma in newborns, with incidence

rates varying across different populations.^[2] Although these fractures are generally benign and amenable to conservative management, they may cause considerable anxiety for families and give rise to clinical and medicolegal discussions among healthcare professionals.^[3]

Address for correspondence: Seniye Burcu Torumtay Aliç, MD. Department of Gynecology and Obstetrics, Hitit University Faculty of Medicine, Çorum, Türkiye

Phone: +90 532 515 29 13 **E-mail:** sbtorumtay@gmail.com

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The development of clavicle fractures is multifactorial, resulting from the interaction of maternal, fetal, and obstetric variables. Advanced maternal age, maternal obesity, gestational or pregestational diabetes, fetal macrosomia, shoulder dystocia, and operative vaginal delivery (OVD) have been identified in the literature as major risk factors.^[4,5] In particular, the effects of maternal diabetes on fetal bone metabolism and its association with an increased tendency toward macrosomia contribute to elevated mechanical stress on the shoulder girdle during delivery.^[6] Moreover, cesarean delivery (CD) does not completely eliminate the risk of clavicle fractures; similar injuries have been reported in neonates delivered by cesarean section, especially during difficult extractions and obstetric maneuvers.^[4,7]

The Robson classification, developed to standardize obstetric practice, has established a universal framework for evaluating modes of delivery. However, studies investigating the relationship between Robson groups and birth-related neonatal fractures remain limited. While existing literature suggests that difficult or assisted deliveries and certain obstetric risk profiles may be associated with neonatal skeletal injuries, large-scale series providing a detailed analysis of this relationship are scarce.^[8]

Although clavicle fractures are most often isolated injuries, a small proportion of cases may be accompanied by more severe neurological complications, such as brachial plexus injuries (BPI).^[9,10] For this reason, a multidisciplinary approach to the evaluation of affected neonates is required. Favorable functional outcomes can be achieved through early diagnosis using ultrasonography or plain radiography, along with appropriate follow-up and treatment strategies.^[9,10]

The aim of this study is to retrospectively evaluate birth-related neonatal clavicle fractures observed at our center over the past decade and to analyze maternal and fetal risk factors, obstetric characteristics, distribution according to the Robson classification, associated BPI, and clinical management processes. By presenting data derived from a single center and a homogeneous patient population, this study seeks to provide a regional contribution to the literature and to enhance clinical awareness.

Methods

This study was designed as a single-center, observational, retrospective analysis of neonates diagnosed with clavicle fractures among those born at XXXXXXXXXXXXXXXX Training and Research Hospital between January 1, 2015, and December 31, 2025. Prior to the study, approval was obtained from the Clinical Research Ethics Committee of Hitit University Faculty of Medicine (Approval No.: 2026-04

/ Date: January 13, 2026), and the necessary institutional permissions were secured. The study was conducted in accordance with the principles of the Declaration of Helsinki.

All live-born neonates who were diagnosed with clavicle fractures either during delivery or within the first 72 hours postpartum, based on clinical and/or radiological findings, were included in the study. Neonates with a prenatally known congenital bone disease and those with incomplete essential obstetric or neonatal records were excluded.

Data were obtained through review of the Hospital Information Management System (HIMS), delivery records, neonatal medical files, and radiology archives. Patient identification information was kept confidential, and anonymized data sets were used throughout the analysis. Recorded maternal variables included maternal age, gravidity, parity, mode of delivery (vaginal delivery [VD], CD, OPV), use of labor induction, and delivery group according to the Robson classification. Fetal and neonatal variables included gestational age, sex, birth weight, presence of macrosomia (≥ 4000 g), fetal position and presentation (cephalic, breech, etc.), and whether the pregnancy was singleton or multiple.

The diagnosis of clavicle fracture was based on clinical findings such as crepitation, localized tenderness, edema, and asymmetry of the Moro reflex detected on physical examination and/or findings from direct radiographic (X-ray) imaging. The side of the fracture (right/left) and the presence of an associated BPI were recorded.

To evaluate the multidisciplinary clinical approach, the response time for orthopedic consultations, calculated in minutes, was documented for cases in which consultation was requested. All cases were managed conservatively, consisting of immobilization with bandaging and clinical follow-up. No cases required surgical intervention.

Statistical Analysis

Statistical analyses were performed using IBM SPSS Statistics software (IBM Corp., Armonk, NY, USA). The distribution of continuous variables was assessed using the Kolmogorov–Smirnov test. Continuous variables with normal distribution were expressed as mean $\pm$ standard deviation, while those without normal distribution were presented as median (minimum–maximum). Categorical variables were reported as numbers and percentages (%). For intergroup comparisons, the independent samples t-test was used for normally distributed continuous variables, and the Mann–Whitney U test was applied for non-normally distributed continuous variables. Comparisons of categorical variables were performed using the chi-square test or Fisher's exact test when expected cell counts were insufficient.



Figure 1. Anteroposterior chest radiographs of two different neonates demonstrating clavicle fractures. Right clavicle fracture identified as a cortical discontinuity at the Midshaft region.

Due to the limited number of cases with accompanying BPI, advanced multivariable analyses were not conducted for this subgroup; related data were presented using descriptive statistics, and comparisons were interpreted with caution. Associations between mode of delivery, presence of operative VD, maternal and fetal variables, and clinical findings were evaluated using univariate analyses. A p-value of <0.05 was considered statistically significant.

Results

Within the scope of the study, a total of 136 neonates diagnosed with birth-related clavicle fractures at our center between January 1, 2015, and December 31, 2025, were evaluated. During the same period, 33,722 deliveries occurred at our institution, corresponding to an incidence of 0.40% (4.0 per 1,000 live births). All fractures were located at the Midshaft of the clavicle (Fig. 1).

Maternal and Obstetric Characteristics

The mean maternal age was 27.27 ± 4.49 years (range: 18–41), with the majority of cases occurring in the 25–34-year age group (58.1%). Adolescent pregnancies accounted for 7.3% of cases (Table 1).

Regarding parity, 33.1% of mothers were primiparous, and 66.9% were multiparous. VD was the predominant mode of birth (97.1%), while cesarean section accounted for 2.9% of cases. OPV was performed in 4.5% of vaginal births, and labor induction was used in 2.9% of cases (Table 1).

Fetal and Neonatal Characteristics

Of the neonates, 44.9% were male, and 55.1% were female. The mean gestational age was 38.55 ± 1.28 weeks, and the mean birth weight was 3585 ± 320.230 g. Cephalic presentation was observed in 98.5% of cases. Right-sided clavicle

fractures were more common than left-sided fractures. BPI was identified in four neonates (2.9%), and 13.2% of cases required NICU admission (Table 2).

Comparison According to Parity

Maternal age was significantly higher in primiparous women compared to multiparous women ($p=0.003$). No statistically significant associations were observed between parity and mode of delivery, fetal presentation, or onset of labor (Table 3).

Operative Vaginal Delivery and Brachial Plexus Injury

Neonates with BPI had higher median birth weights compared to those without injury, although this difference did

Table 1. Distribution of maternal age, parity, mode of delivery, and labor induction among neonates with clavicular fractures (n=136)

Variable	Value n (%)
Maternal age (years)	
<20 (Adolescent)	10 (7.3)
20–24	28 (20.6)
25–34	79 (58.1)
≥35 (Advanced maternal age)	19 (14.0)
Parity	
Primiparous	45 (33.1)
Multiparous	91 (66.9)
Mode of delivery	
Vaginal delivery (VD)	132 (97.1)
VD with intervention (vacuum/forceps)	6 (4.5)
VD without intervention	126 (95.5)
Cesarean section	4 (2.9)
Labor induction	
Yes	4 (2.9)
No	132 (97.1)

Table 2. Neonatal and fetal characteristics

Variable	Value
Sex (Male/Female) n (%)	61 (44.9)/75 (55.1)
Mean gestational age (weeks)	38.55±1.28 (36-41)
Mean±SD (min-max)	
Mean birth weight (g)	3585.07±320.230
Mean±SD (min-max)	(2750-4580)
Fetal presentation n (%)	
Cephalic presentation	134 (98.53)
Breech presentation	2 (1.47)
Side of clavicular fracture n (%)	
Right	87 (63.97)
Left	49 (36.03)
Brachial plexus injury n (%)	
Yes	4 (2.94)
No	132 (97.06)
NICU admission n (%)	
Yes	18 (13.23)
No	118 (86.76)

Table 4. Factors associated with brachial plexus injury

Variable	BPI present (n=4)	BPI absent (n=132)	p
Birth weight (g), median (IQR)	3925 (813)	3595 (388)	0.083
Operative vaginal delivery	6 (100%)	0 (0.0%)	1.000
Non-operative vaginal delivery	121 (96.8%)	4 (3.2%)	
Fetal presentation			
Cephalic presentation	4 (3.0%)	130 (97.0%)	1.000
Breech presentation	0 (0.0%)	2 (100%)	
Side of fracture			
Right	2 (50%)	85 (64.39%)	0.456
Left	2 (50%)	47 (35.61%)	
Postnatal follow-up location			
Ward care	2 (50%)	116 (87.88%)	0.085
NICU admission	2 (50%)	16 (12.12%)	

NICU: Neonatal intensive care unit. Due to the small number of cases with brachial plexus injury, categorical variables were analyzed using the Fisher's exact test. Continuous variables were compared using the Mann-Whitney U test.

not reach statistical significance ($p=0.083$). All cases with BPI occurred following OPV; however, this association was not statistically significant (Table 4).

Robson Classification

Clavicle fractures were predominantly observed in low-risk obstetric groups, particularly Robson Group 1 (46.3%) and Group 3 (48.5%). Cesarean deliveries were observed only in Robson Groups 5 and 7 (Table 5).

Table 3. Comparison of maternal and obstetric characteristics according to parity

Variable	Nulliparous (n=45)	Multiparous (n=91)	p
Maternal age (years)	28 (5)	25 (6)	0.003
Vaginal delivery	45 (34.1%)	87 (65.9%)	0.302
Cesarean section	0 (0.0%)	4 (100%)	–
Operative vaginal delivery	6 (100%)	0 (0.0%)	–
Fetal presentation			
Breech presentation	0 (0.0%)	2 (100%)	1.000
Cephalic presentation	45 (33.5%)	89 (66.4%)	
Onset of labor			
Spontaneous	43 (32.6%)	89 (67.4%)	1.000
Induction	2 (50.0%)	2 (50.0%)	–

Continuous variables were analyzed using the Mann-Whitney U test, and categorical variables were analyzed using the Chi-square test or Fisher's exact test, as appropriate.

Table 5. Distribution of cases according to the Robson classification system

Robson group	Vaginal delivery n (%)	Cesarean section n (%)	Total (n)
Group 1	63 (100)	0 (0)	63
Group 2	2 (100)	0 (0)	2
Group 3	64 (97.0)	0 (0)	64
Group 4	2 (100)	0 (0)	2
Group 5	1 (33.3)	2 (66.7)	3
Group 7	0 (0)	2 (100)	2
Total	132 (97.1)	4 (2.9)	136

Discussion

In this study, birth-related neonatal clavicle fractures were retrospectively evaluated in a homogeneous patient population over a ten-year period at a single center. The most notable finding was that clavicle fractures predominantly occurred following VD and in cases considered obstetrically low risk. This result indicates that clavicle fractures are not complications exclusive to high-risk deliveries and may also arise during routine obstetric practice.

The incidence of neonatal clavicle fractures in our cohort was 4.0 per 1,000 live births, which is consistent with rates reported in previous population-based studies. Neonatal clavicle fractures are described in the literature as the most common birth-related skeletal injury.^[1,2] In our study, the restriction of birth trauma exclusively to clavicle fractures ensured homogeneity of fracture type and allowed clearer interpretation of the results. In this respect, our study offers a methodological advantage over heterogeneous series in which different types of fractures are evaluated together.

Analysis of maternal age distribution revealed that the majority of cases occurred in the 25–34-year age group. Although advanced maternal age has been reported as a risk factor in some studies,^[4,5] the clustering of clavicle fractures within an obstetrically low-risk age group in our cohort suggests that maternal age alone is not a decisive determinant. Similarly, the predominance of multiparous mothers among cases is consistent with previous studies reporting that parity alone is not an independent risk factor.^[3]

With regard to mode of delivery, the predominance of clavicle fractures following VD is consistent with the existing literature.^[2,4] While CD is known to reduce, but not eliminate, the incidence of clavicle fractures,^[2] the limited number of cesarean cases in our study allowed only descriptive evaluation of this association. In a multicenter analysis, Gencer et al.^[11] reported that clavicle fractures were most commonly observed in neonates with cephalic presentation delivered vaginally. Similarly, the vast majority of cases in our study involved cephalic presentation.

Although the rate of OPV was low, the fact that all cases with associated BPI occurred following OPV is clinically noteworthy. Despite the lack of statistical significance, this observation aligns with the literature suggesting a relationship between OPV and neurological injuries.^[3,9] Given the limited number of cases, this finding should be interpreted with caution.

Evaluation of birth weight demonstrated higher weights among neonates with BPI. This finding is consistent with studies highlighting the association between increased fetal weight and birth-related trauma.^[5,6] In our study, assessing birth weight as a continuous variable rather than categorizing macrosomia provided a more cautious and data-appropriate analytical approach.

Assessment based on the Robson classification represents one of the original aspects of this study. The concentration of clavicle fractures in low-risk groups, such as Robson Groups 1 and 3, underscores that these injuries are not confined to high-risk obstetric categories. Given the limited number of studies examining the relationship between Robson classification and neonatal fractures, this finding contributes valuable data to the literature.^[8]

Ozdogar et al.^[12] suggested that labor induction may be a potential risk factor for neonatal clavicle fractures. In our study, the number of cases with a history of induction was limited, and none of these neonates exhibited BPI or required admission to the neonatal intensive care unit (NICU). This suggests that, while induction may play a role in fracture occurrence, it may not independently predict severe neurological or systemic complications.

From a diagnostic and clinical management perspective, the identification of clavicle fractures through physical examina-

tion in all cases emphasizes the importance of careful neonatal assessment. Although alternative diagnostic modalities, such as ultrasonography, have been reported, plain radiography remains widely used.^[9,10] The successful conservative management of all cases in our study, with no requirement for surgical intervention, is consistent with reports indicating a favorable prognosis for neonatal clavicle fractures.^[10,13]

The mean orthopedic consultation response time of 106.7 minutes highlights the effectiveness of a multidisciplinary approach. Although quantitative evaluations of consultation response times are scarce in the literature,^[1,10] early orthopedic assessment is considered important for confirmation of diagnosis, initiation of appropriate conservative management, and family counseling. Furthermore, the fact that only a subset of neonates with BPI required NICU admission suggests that this neurological complication is not invariably associated with severe clinical outcomes. Consistent with reported NICU series, neurological findings accompanying clavicle fractures often regress with conservative follow-up.^[13–15]

This study has several limitations. Due to its retrospective design, important variables such as maternal diabetes status and metabolic control could not be evaluated. In addition, the small number of cases with BPI precluded advanced multivariable analyses. The absence of a separate control group should not be regarded as a methodological weakness but rather reflects the nature of the research question; the primary objective of the study was to characterize obstetric features and delivery dynamics among cases with clavicle fracture, with incidence calculated using the entire birth population as the reference. Nevertheless, the evaluation of a homogeneous cohort consisting solely of neonates with clavicle fracture, the inclusion of a large ten-year study period, and the use of a standardized obstetric framework, such as the Robson classification, represent important strengths of the study.

Conclusion

This study demonstrates that birth-related neonatal clavicle fractures are not limited to high-risk obstetric conditions but frequently occur in pregnancies considered low risk and following routine vaginal deliveries. The predominance of cases within low-risk Robson Groups 1 and 3 highlights that this clinical entity should be considered in every delivery. Neonatal clavicle fractures generally follow a benign course, and early diagnosis, timely orthopedic consultation, and a multidisciplinary approach render conservative management both effective and safe. These findings contribute to increased clinical awareness and provide a foundation for future large-scale, multicenter studies incorporating maternal metabolic factors.

Disclosures

Ethics Committee Approval: The study was approved by the Hitit University Clinical Research Ethics Committee (no: 2026-04, date: 13.01.2026).

Informed Consent: Informed consent was obtained from all individual participants included in the study or their legal representatives.

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