Chiropractic management of musculoskeletal disorders associated with a neonatal clavicle fracture: a case report

By Amelie Bourque, DC [1]

1. Private practice, Montreal, Quebec, Canada
Email: bourque.amelie@hotmail.com

ABSTRACT

Objective: To present chiropractic management of a 5-month-old patient with multiple complaints related to a neonatal clavicle fracture and the resolution of all symptoms after 4 treatments. **Case presentation:** A 5-month-old male presenting with history of a fractured left clavicle, fussing, irritability, crying, grunting, rigidity, abnormal positioning of his left arm at rest, breastfeeding difficulties on the right side and apparent discomfort lying on his stomach. He presented to a chiropractic office after consulting various health professionals without improvement. **Interventions, and outcomes:** Various techniques, including touch and hold, sacro-occipital, light vibration and mobilization were used to treat the 5-month-old male infant during the 4 visits complimented by home exercises. Objective findings of subluxations of the left clavicle, left 1st rib, T2, T5, occiput, left scapula and left gleno-humeral joint were confirmed with static palpation, motion palpation of the spine and the upper limb. Following 4 visits, grunting and crying ceased, the left arm was in normal position at rest with complete active and passive range of motion, breastfeeding successfully bilaterally without nipple pain for the mother. The child also demonstrated improvement in motor development. **Conclusion:** Chiropractic management should be considered collaboratively with medical follow-up in cases of birth trauma such as clavicle fracture. Further research is warranted to asses the long-term musculoskeletal sequelae with similar cases of neonatal birth trauma.

Key Words: case report, chiropractic, subluxation, neonatal clavicle fracture, footling breech presentation, birth trauma, Caesarean section, breastfeeding difficulties, irritability, sleep disorder.

Introduction

Neonatal clavicle fracture is defined as a trauma directly related to vaginal delivery or caesarean section.[1] It is considered as the most commonly fractured bone in obstetrics, occurring in 0.2% to 3.5% of all births.[1-3] Usually seen during vaginal deliveries, clavicle fractures in newborns are associated with shoulder dystocia, birth weight, vacuum deliveries, prolonged second stage of labor, gestational age, instrumental vaginal delivery, maternal age, height and obesity.[2,3] Generally associated with a lower risk of birth trauma, clavicle fractures can also occur during caesareans.[4] A retrospective review of caesarean deliveries with neonatal clavicle fracture identified an incidence of 0.05% for this birth trauma.[2] In both, vaginal or caesarean deliveries, pathophysiology of the clavicle fracture is still unclear. Some authors associated this trauma with the pressure of the fetal shoulder on the mother's symphysis during the contractions associated with a vaginal delivery and the baby's birth weight with a Caesarean delivery.[2,3] Considering previous studies, prognosis of clavicle fractures is benign without sequelae and without requiring treatment.[2,3] Neurological injuries associated with clavicle fracture, such as brachial plexus palsy, are well documented as possible outcomes. But there is no current study presenting the possibility of musculoskeletal sequelae associated with birth trauma.

Diagnosis is usually confirmed with physical examination and radiography. Principle signs of a clavicle fracture in a newborn patient included swelling, asymmetric Moro reflex, tenderness, crepitation in the affected shoulder and crying when the affected upper arm is moved.[3,5] Neonatal clavicle fractures can be undiagnosed at birth and only confirmed during the days following childbirth. A retrospective review demonstrated an incidence of 86.2% confirmed diagnosis before discharge from the hospital with a physical examination or radiography.[3]

The aim of this current case report is to present the association of neonatal clavicle fracture with musculoskeletal disorders and related effects on the physical development of the baby and his well-being.

Methods

The following electronic databases were used to identify previously published studies: Pubmed, Google Scholar, Mantis, Index to Chiropractic Literature, ICPA Research. Search keywords included: birth trauma, neonatal clavicle fracture, cesarean delivery, pediatric, chiropractic, manipulation and treatment. Supporting publications used in this paper: Case study, systematic review and retrospective review. Other books and articles were used to provide supporting information.

Case report

A 5-month-old male infant was presented by his mother for a chiropractic evaluation. Chief complaints included fussing, irritability, crying, grunting, rigidity, abnormal position of his left arm, 2 weeks of constipation, breastfeeding difficulties on the right side and apparent discomfort lying on his stomach. The mother associated all these complaints to the fracture of his left clavicle he had sustained during his birth.

The multiparous mother described her second pregnancy with some complications. At 11 week of gestation, she received a diagnosis of one healthy embryo, one non-viable embryo and a subchorionic hematoma of 5 cm located near the cervix with a recommendation of rest. At 13 week of gestation, bleeding and cramps starts related to an hypertrophy of the hematoma. At 15 week of gestation, they confirmed the presence of a second hematoma, she was put on bed rest for the remainder of her pregnancy and prescribed a prometrium treatment to avoid miscarriage risk. At 21 week of gestation, the subchorionic hematoma has resorbed but an amniotic fluid sludge was diagnosed increasing the risk of cervix inflammation and preterm labor. An antibiotic was prescribed for the mother preemptively to manage any risk of infection. At 23 week of gestation, preterm labor was no longer a risk, but the ultrasound showed a low fetal weight (in the 12th percentile). Her obstetrician recommended ultrasound every two weeks to evaluate the risk of intrauterine growth restriction. Fetal weight varied between the 5th and the 10th percentile. The baby was born at 40 week with a birth weight of 2,925g, in the 5th percentile, without any associated complication.

The baby was delivered with an emergency Caesarean section because of a footling breech presentation. At 39 weeks and 5 days of gestation, the obstetrician detected that the fetus was in a breech position. The next day, they attempted an external cephalic version to try to turn the fetus to a vertex position. At the end of the procedure, with fetal ultrasound, they confirmed the fetus was vertex with his feet close to his head. The mother chose to postpone the planned Ceasarean until 41 weeks of gestation allow for the baby to complete his version. At 40 weeks and 1 day of gestation the mother underwent a fetal ultrasound to confirm the fetal position. The fetus was in a footling breech position so they decided to schedule an emergency Caesarean the same night. Upon going home to prepare, 30 minutes after leaving the hospital, the mother had a spontaneous rupture of her membranes without any detectable uterine contractions. The contractions started naturally when she came back to the hospital 30 minutes later. Upon performing a vaginal examination, they discovered that she was dilated to 10 cm and a fetal foot had passed through the cervix. The Caesarean section immediately performed and completed in 5 minutes.

APGAR scores were 7 at 1 minute and 9 at 5th minutes, because the neonate did not cry during the first minute. The mother reported a rapid and stressful birth, 3 hours from onset to delivery. The first pediatrician did a physical exam on the neonate after 2 hours of life without noticing any abnormality. On the 4th day, a second pediatrician did a physical evaluation and detected a left clavicle fracture. The pediatrician proposed an x-ray to confirm the fracture, but parents declined it. The parents did not receive any specific recommendations for care or precautions around the clavicle fracture. The pediatrician told the parents that the fracture was benign, the prognosis was good, and that healing should occur without any risk of complication or sequelae.

The mother observed a change in her infant's behavior after his second week of life starting with breastfeeding difficulties on the ride side, rigidity in his global tonus with a tendency to arch his back and an abnormal positioning of his left arm in extension when she was breastfeeding him. At 3 months, the mother noticed persistent grunting accentuated during tummy time and lying on the bed. The mother visited multiple health care professionals without seeing any improvements in her child

The mother noted a decrease in grunts and a stronger latch while her baby was taking acetaminophen. Medical physical assessments were normal and showed no disorders related to the clavicle fracture. However, convinced that her son was suffering because of his clavicle, the mother decided to consult a chiropractor.

Physical Exam

The infant was agitated, grunting and crying upon physical examination with evidence of rigidity in his global tonus. General posture in extension was observed. Head rotation was slightly limited to the left during passive rotation. Upon evaluating left shoulder mobility the infant was distressed and reacted by contracting the musculature around the shoulder girdle. The mother mentioned the infant always medially rotated and extended his left arm backward when she was breastfeeding him and he did not want to rest on his left arm during tummy time. Neurological examination revealed intact Galant, Babinski and Landau reflexes.

Objective findings of subluxations of the left clavicle, left 1st rib, T2, T5, occiput, left scapula and left gleno-humeral joint were confirmed with static palpation and motion palpation of the spine and the upper limb. Left clavicle was restricted in depression (supero-inferior) and protraction (postero-anterior) associated with left trapezius and scalene hypertonicity. Palpating the left first rib in sitting and su-

Date	Health professional	Complaints (C)/results (R)
21/06/2017	Osteopathy	**C:** discomfort of the left arm, difficulty turning his head to the left side, breastfeeding difficulties on the right side, reflux **R:** improved head rotation to the left side and breastfeeding for only a few days
27/06/2017	Osteopathy	**C:** same as the last visit **R:** improved head rotation to the left side and breastfeeding for only few days
10/07/2017	Acupuncture	**C:** Reflux and gas **R:** relaxation
11/07/2017	General practioner (GP)	**C:** abnormal position of his left arm, he seemed to be suffering, reflux **R:** Prevacid prescribed for the reflux, recommendation to a breastfeeding clinic
13/07/2017	Intl board-certified lactation consultants	**C:** Breastfeeding difficulties on the right side **R:** detection of a tongue-tie and recommendation for a frenectomy
14/07/2017	Dentist	**C:** Tongue-tie and breastfeeding difficulties on the right side **R:** Frenectomy without improvement in the breastfeeding
19/07/2017	GP	**C:** Routine visit, vaccination and follow-up of Prevacid effectiveness to reduce reflux **R:** Continue Prevacid (despite lack of improvement in the child's reflux), normal physical examination
21/07/2017	Osteopathy	**C:** to improve tongue and jaw muscles mobility following the frenectomy **R:** No change
28/07/2017	IBCLC and Paediatrician	**C:** Breastfeeding difficulties on the right side, abnormal position of his left arm when he is on his stomach **R:** Tongue-tie release was incomplete following the first frenectomy. IBCLC recommended a second frenectomy since breastfeeding was still difficult on the right side.
31/07/2017	Family doctor	**C:** Vaccination, evaluation of Prevacid effectiveness to reduce reflux **R:** Continue Prevacid (child still have reflux). Normal physical examination
01/08/2017	IBCLC and Doctor	**C:** Fever (in reaction to the vaccination) **R:** frenectomy follow-up
03/08/2017	Osteopathe in France	**C:** Abnormal position of his left arm when he's on his stomach, breastfeeding still difficult, better suckling with acetaminophen (Tempra) **R:** Normal physical examination
04/08/2017	Paediatrician in France	**C:** Routine visit (weight) **R:** Normal physical examination
19/09/2017	Nurse practitioner	**C:** Grunting, fussing, reflux, breastfeeding difficulties **R:** Increase the initial dose of Prevacid (ineffective at current dose), weight loss (5th to 3rd percentile)
10/10/2017	Paediatrician	**C:** breastfeeding difficulties, refusing the breast, grunting, agitated sleep **R:** The mother took fenugreek and blessed thistle to improve her milk production, Normal physical examination of the baby
11/10/2017	GP	**C:** breastfeeding difficulties, refusing the breast, grunting, agitated sleep **R:** Recommendation to start with solid food and take medication to improve milk production. The mother declines the medication due to the associated side effects.
30/10/2017	Osteopathy	**C:** Abnormal position of his left arm when he's on his stomach **R:** lots of muscles tension, performs manual therapy on his stomach and ribs without noticeable change
24/11/2017	Chiropractic	**C:** Fussing, irritability, crying, grunting, rigidity, abnormal position of his left arm, breastfeeding difficulties on the right side and hard times to stay on his stomach **R:** Improvement in breastfeeding on the right side with a stronger latch, decrease in grunting, relaxation and more easily consolable, improving the position of the left arm and maintaining the ventral position for longer without crying

Table 1. Timeline of health professional visits.

pine position confirmed the important loss of supero-inferior mobility. T2 had posterior and right rotational misalignment. T5 was found posteriorly restricted with significant contracture in paraspinal musculature. Palpation of the occiput revealed a restriction in flexion with hypertonicity in suboccipital musculature. Left scapula was restricted in both internal and external rotation associated with rotator cuff musculature contracture. Left gleno-humeral joint was found to be restricted in flexion, abduction and internal rotation combined with hypertonicity of the left pectoralis major.

Diagnosis and Treatment

A pediatrician confirmed the clavicle fracture at the time of discharge from the hospital on the 4th day of life during a physical examination. Parents declined the proposed radiography because according to the doctor, the outcome would not affect the treatment plan. The significant restrictions around the left shoulder girdle, including the clavicle, scapula, gleno-humeral joint, first rib and upper thoracic were all associated to the left clavicle fracture. The chiropractic diagnosis was a left shoulder girdle dysfunction associated with a neonatal fracture of the left clavicle and multiple subluxation complexes.

The 5-month-old patient was treated by a chiropractor once a week for the first two weeks and then two more time during the next 2 months for a total of 4 visits. Chiropractic treatment was initiated following the physical examination at the first visit. Informed consent was obtained after the report of finding at the first visit. A combination of different techniques were used to treat joint restrictions. Left clavicle, 1st rib, scapula and gleno-humeral joint were adjusted with light mobilization and vibration because the area was sensitive to pressure. Sacro-occipital technic (SOT) was used to treat the occipital restriction and to release the tension in the fascia and the paraspinal musculature. Thoracic spine (T2 and T5) was treated with the "touch and hold" technique by holding a specific, light pressure on the fixated vertebrae. The left shoulder girdle musculature was treated using myofascial release and massage. The parents received home exercises recommendation to reduce tension and to improve motor development.

Outcomes

Immediately after the first treatment, the mother observed significant changes in her child's behavior and well-being. In the following days, he was more calm and relaxed, his left arm was no longer held in extension, breastfeeding on the right side was easier with a better latch and transfer, digestion was normalized (he had been constipated for the last two weeks), less grunting, more easily consoled and more comfortable in tummy time. At the 3rd visit, it was noted that there was no more grunting, no more crying during the tummy time and he was able to sit unassisted. After the 4th and last visit, he had normal range of motion of his left upper limb without hypertonicity in the musculature around the shoulder girdle, no residual breastfeeding issues, radically positive changes in his motor development, staying longer in the prone position, sitting by himself and crawling. The mother confirmed he was no longer grunting or crying for inexplicable reasons. Chiropractic care was concluded after the 4th visit because parents moved to another city but they were greatly encouraged to continue treatment in another chiropractic clinic as needed. The parents reported no adverse events related to any of the treatments given.

Discussion

In utero, the first bone to ossify is the clavicle and it is the most commonly fractured bone at birth. Usually, birth related clavicle fractures are nondisplaced greenstick type fractures and can be confirmed with "crunchiness" upon palpation of the clavicle. Complete healing of the clavicle fracture takes about 2 to 3 weeks and during this period, parents should avoid lifting the child by the arm to prevent aggravation of the injury.[6] Sometimes, pediatricians will recommend bracing to stabilize the clavicle but in most cases no treatment is needed.[7]

In this case, parents did not receive any recommendations before leaving the hospital on the specific care of a clavicle fracture. Even without serious neurological sequelae associated with the clavicle fracture, parents should be advised of the precaution they need to take with their newborn. Specific recommendations include handling their baby gently, avoid pulling the arm to lift the baby and to avoid lying baby on the affected side in his bed and also during breastfeeding.[8,9] With these recommendations, parents could have avoided positioning their baby on the affected side, which would have made breastfeeding easier and less painful for the infant and the mother. Right breastfeeding was very difficult suggesting the position was painful for the baby.

Many studies on clavicle fractures have been reported and there is no report of frequent complications. In some case, brachial plexus palsy with limited movement of the wrist and arm and phrenic nerve paralysis were associated with the fracture but the patient had no related sequelae.[3,7,8] There is limited information concerning long-term sequelae associated with neonatal clavicle fracture. Biomechanical dysfunctions such as restricted joint mobility, muscles tenderness, sensitivity and limited range of motion (ROM) are not directly associated to the clavicle fracture in the literature. However, in this case, the patient had several biomechanical constraints associated with the birth trauma. Decreased ROM of the glenohumeral, scapulothoracic and sternoclavicular joints, multiple joint restrictions mainly at

Visit 1 — 24/11/2017		
Subjective findings:	**Physical findings:**	**Treatment and recommendations:**
Left shoulder girdle feeling very tight and restricted, lots of grunting, breastfeeding difficulties on the right side and constipation	Left clavicle: decreased mobility on static palpation in depression and protraction Left scapula: decreased motion palpation on internal and external rotation, left rotator cuff hypertonic and sore Left gleno-humeral joint: decreased mobility on motion palpation in abduction, flexion and internal rotation; left pectoral hypertonic Left 1st rib: decreased inferior motion when palpated supine and sitting T2: decreased mobility on static palpation and motion palpation in extension and left rotation with tenderness in the paraspinal musculature T5: decreased mobility on motion palpation on extension Cranial bones: decreased mobility of the occiput in flexion Musculature findings: Hypertonic left rotator cuff with crying on contact, left trapezius, left pectoralis major, left scalene, bilateral paraspinal and suboccipital.	AS occiput (SOT) T2 (sustained contact) T5 (sustained contact) Left 1st rib (vibration) Scapulo-thoracic (mobilization) Left clavicle (mobilization) Soft tissue work: Muscles stretching with passive trunk flexion Muscles massage on left rotator cuff, bilateral paraspinal, left pectoralis major Recommendations: - Paraspinal muscles massage - Happy baby exercise* - Passive trunk flexion*
Visit 2 — 01/12/2017		
Subjective findings:	**Physical findings:**	**Treatment and recommendations:**
Decreased tension in the left shoulder girdle with improved mobility, decreased grunting, better time on his tummy without crying, better sucking during breastfeeding, normal bowel movement (no more constipation), more relax	Left clavicle: decreased anterior mobility of the left clavicle during a shoulder protraction. Left 1st rib: decreased superior to inferior mobility on motion palpation when supine with improvement compared to the last visit T2: decreased mobility on static palpation and motion palpation in extension and left rotation with tenderness in the paraspinal musculature T5: decreased mobility on motion palpation in extension Left gleno-humeral joint: decreased mobility on motion palpation in abduction, flexion and internal rotation Cranial bones: decreased mobility of the occiput in flexion Muscles findings: Hypertonic left rotator cuff, left trapeze, left pectoralis major, bilateral paraspinal and suboccipital.	AS occiput T2 (sustained contact) T5 (sustained contact) Left 1st rib (vibration) Left clavicle mobilization Left gleno-humeral traction Soft tissue work: Muscles stretching with passive trunk flexion Muscles massage on left rotator cuff, bilateral paraspinal, left pectoralis major Recommendations: Exercises - Happy baby - Passive body flexion - Shoulders adduction/abduction*
Visit 3 — 15/12/2017		
Subjective findings:	**Physical findings:**	**Treatment and recommendations:**
Sit without any support, cold and cough (started daycare)	Left clavicle: decreased anterior mobility of the left clavicle during a shoulder protraction. T2: decreased mobility on motion palpation in left rotation with improved mobility in extension Left 1st rib: decreased superior to inferior mobility on motion palpation when sitting and supine Cranial bones: decreased mobility of the occiput in flexion Muscles finding: Hypertonicity in paraspinal musculature, left trapeze and left pectoralis major	AS occiput T2 (sustained contact) Left 1st rib (vibration) Left clavicle mobilisation Soft tissue work: Muscles stretching with passive trunk flexion Muscles massage of paraspinal and left pectoralis major Recommendation: -Passive body flexion -Happy baby
Visit 4 — 19/01/2018		
Subjective findings:	**Physical findings:**	**Treatment and recommendations:**
Dental thrust, no more grunting and crying, wants to crawl and stays long time on his tummy. Breastfeeding is now complete without pain.	Left 1st rib: light restriction during superior to inferior mobility on motion palpation T2: decreased mobility on motion palpation in left rotation T5: decreased mobility on motion palpation in extension	T2 and T5 (sustained contact) Left 1st rib (vibration) Soft tissue work: Muscles stretching with passive trunk flexion Muscles massage of paraspinal and left pectoralis major Recommendation: - Paraspinal muscles massage - Passive body flexion

Table 2. Chiropractic management notes. * See Figure 1, 2 and 3.

the left first rib and clavicle, hypertonicity and tenderness of left shoulder girdle muscles all could potentially have been associated with the trauma that caused the original clavicle fracture. Despite orthopedic management of the bone fracture, patients who had neonatal clavicle fracture should also being seen by a chiropractor. Chiropractic analysis was essential to diagnose of a left shoulder girdle dysfunction associated with a neonatal fracture of the left clavicle and multiple subluxation complexes. Contrary to what we found in the literature, this case suggested that patients could have associated sequelae.

Spear and Alcantara[10] presented a study of a 6-week-old infant born with trauma from vacuum extraction under chiropractic care. A male infant presented with chief complaint of infantile colic, acid reflux, restlessness, inability to relax and/or lay on his back, difficulty sleeping and general irritability. The patient had 7 treatments of chiropractic care using Activator and "touch and hold" adjustments. Following these 7 treatments, the mother noticed improvement of the initial complaints and resolution of his digestive problems.

In this case report, restoration of normal ROM of the left clavicle, first rib, shoulder girdle, cranial bones and thoracic spine through chiropractic adjustments allowed an improvement in the child posture, motor development, breastfeeding and well-being. Chiropractic adjustment can be considered safe when modified or adapted for infants with the absence of adverse event following low force adjustment.[11,12]

In conclusion, this case report demonstrates the importance

Figure 1: Happy baby exercise (neutral position). Catch baby's feet and hands together and cradle baby from side to side to relax the paraspinal muscles and encourage baby to roll sideways.

Figure 2: Passive body flexion. Place baby on the forearm supporting his head with hands and by bending elbows create a passive flexion of the body and the baby's head. NOTE: The baby's head should be kept in a neutral position (unlike in the photo where the neck is rotated) to execute this exercise.

Figures 3 and 4: Shoulder adduction/abduction. Catch baby's hands to open arms and create abduction then bring arms closer to the baby's body and across the chest in adduction.

of chiropractic follow-up after a birth trauma such as neonatal clavicle fracture. Chiropractic assessment evaluates biomechanics and neuromusculoskeletal system to determine whether or not there are possible sequelae following a birth trauma. Considering the positive results following chiropractic treatment in this case, chiropractic could be considered as a gentle, safe and modifiable approach to treat infants with co-morbid conditions associated with a clavicle fracture. There is undeniably a significant lack of resources on this subject and more research is needed to support knowledge on chiropractic care of musculoskeletal sequelae associated to a clavicle fracture.

References

1. Beall M, Michael G, Ross M. Clavicle Fracture in Labor: Risk Factors and Associated Morbidities. *Journal of Perinatology* 2001; 21:513-515.

2.Choi HA, Lee YK, Ko SY, Shin SM. Neonatal clavicle fracture in cesarean delivery: incidence and risk factors. *J Matern Fetal Neonatal Med* 2017; 30(14):1689-1692.

3. Eun Sub Ahn, Yeon Kyung Lee, Sun Young Ko, et al. Neonatal clavicular fracture: Recent 10 year study. *Pediatrics International* 2015; 57:60-63.

4. Linder N, Linder I, Fridman E, et al. Birth trauma--risk factors and short-term neonatal outcome. *J Matern Fetal Neonatal Med* 2013; 26(15):1491-1495.

5. Xiang Y, Luo D, Mao P. Preventive nursing of neonatal clavicular fracture in midwifery: a report of six cases and review of the literature. *Clin Exp Obstet Gynecol* 2013; 40(4):584-585.

6. Anrig C and Plaugher G, editor. *Pediatric Chiropractic*. Second ed 2011. Lippincott, Williams &Wilkins and Wolters WKHLW, Philadelphia, Pennsylvania.

7. Wall LB, Mills JK, Leveno K, et al. Incidence and prognosis of neonatal brachial plexus palsy with and without clavicle fractures. *Obstet Gynecol* 2014;123(6):1288-1293.

8. Reiners CH, Souid AK, Oliphant M, Newman N. Palpable spongy mass over the clavicle, an underutilized sign of clavicular fracture in the newborn. *Clin Pediatr* (*Phila*) 2000; 39(12):695-698.

9. Rogers EK, Bolger S, Paul SP. Managing neonates with clavicle fractures. *Midwives* 2015;18:50-52.

10. Spear D, & Alcantara J. Resolution of Birth Trauma Sequelae Following Adjustment of Vertebral Subluxations in an Infant. *Journal of Pediatric, Maternal, & Family Health* 2016; 1:28-31.

11. Vallone SA, Miller JE, Larsdotter A, Barham-Floreani J. Chiropractic approach to the management of children. *Chiropractic & Osteopathy* 2010;18(16).

12. Todd AJ , Carroll MT, Eleanor K, Mitchell EKL. Forces of Commonly Used Chiropractic Techniques for Children: A Review of the Literature. *Journal of Manipulative and Physiological Therapeutics* 2016; 39:401-410.