

Cross sectional Study of Club Foot at Tertiary Care Hospital

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Background: Club foot is the most common congenital deformity of the foot. It causes severe disability resulting in difficulty to walk. Certain epidemiological and environmental factors have influenced the etiology and treatment of club foot deformity. This study was designed to observe these factors and compare them with similar series reported in orthopedic literature.

Study Design: Cross sectional.

Sample Size: There were 104 patients with 168 club feet.

Targeted Population: All the patients with club foot deformity presented in out patients Department of Orthopedics Surgery and Traumatology Unit-I, King Edward Medical University/ Mayo Hospital Lahore were included in this study.

Results: The average age of patients was 6.24 ± 1.32 weeks with male to female ratio (2.46 : 1). Seventy-three patients (70.19%) presented through spontaneous vertex delivery, 14 (13.46%) required caesarean section and 14 (13.46%) required episiotomy to facilitate their births. According to seniority order 48 (46.15%) were first, 12 (11.53%) were second, 17 (16.34%) were third, 7 (6.73%) were fourth, 14 (13.46%) were sixth, 5 (4.80%) were seventh and 1 (0.96%) was fifteenth baby of the family that is a rare birth order with club foot which is hard to find previously published literature. The proportion of club foot was significantly higher in first baby ($p\text{-value} = 0.0000 < 0.0001$). Congenital anomalies associated with club foot had a wide variation of expressions. Most of them are related to connective tissue abnormalities responsible for club foot deformity.

Conclusion: According to this study club foot is more common in males having low socioeconomic status. Positive family history in a case of club foot deformity is of great value as it has its genetic implications. Crowding phenomena plays a definitive role in the etiology as incidence of club foot deformity is significantly high in first born babies. Mode of delivery and maturity were found insignificant in this study.

Key Words: Epidemiology of Club foot.

Introduction

Club foot is a common and challenging musculoskeletal deformity.¹ It represents a congenital dysplasia of musculoskeletal tissues distal to the knee.² All the medial soft tissues distal to the knee are contracted. This deformity has intraosseous and interosseous components resulting from abnormal bony relationship. It mainly affects the relationship of the talus with the tarsal bones so that, these bones assume extreme position of flexion, adduction and inversion at birth.³ This results in hind foot equinus, hind foot varus and fore foot varus⁴. In cases of severe club foot deformity gait is grossly affected and neglected patient walks on their ankles.^{4,5}

Club foot is an ancient problem of humans as it is depicted in 5000 years old Egyptian hieroglyphs. It was first reported in medical literature by Hippocrates 400 years BC. He was the first to document the hypothesis to explain the etiology and treatment of club foot. Today, a number of hypothesis about etiology of club foot remain but research findings do not clearly support any particular one. The mechanism by which club foot develops is unknown but mechanical, neurological, muscular, bony, connective tissue and vascular mechanisms all have been proposed.⁶ The etiology of

club foot is not well elucidated while both genetic and environmental factors are frequently implicated and a little is known about environment risk factors.⁷ It is a fact that even today club foot is still a challenge for paediatric orthopaedic surgeons.⁸

In this study, 104 patients with 168 club feet were studied in terms of environmental factors, pattern of deformity and associated anomalies for comparison with the similar series reported in the orthopedic literature.

Objective

The objectives of this research project were to study the epidemiological; demographical and environmental factors associated with club foot in our population and compare them with similar series reported in orthopedic literature.

Materials and Methods

Study Design: Cross sectional Study.

Settings: This study was done in the Department of Orthopedics Surgery and Traumatology Unit-I, King Edward Medical University / Mayo Hospital Lahore.

Duration: This study was completed in 18 months.

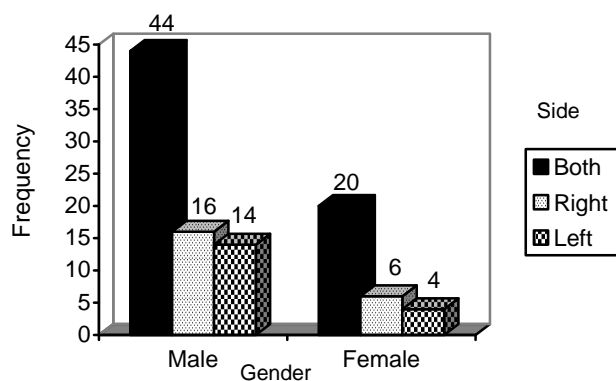
Sample Size: 104 patients with 168 club feet.

Targeted Population: All the patients with club foot deformity presented in out patients Department of Orthopedics Surgery and Traumatology Unit-I, King Edward Medical University / Mayo Hospital Lahore were included in this study.

Statistical Techniques: All the data was analyzed using SPSS. The metric data was presented in form of mean \pm S.D along its range (Max-Min). The qualitative data was presented in form of frequency and percentages. Nonparametric chi-square test for proportion was used to see the significance of any category. P-value less than 0.05 was considered as significant.

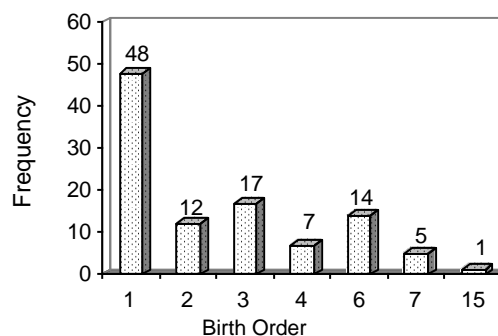
Results

The age of presentation for treatment ranged from 1-52 weeks with a mean of 6.24 ± 1.32 weeks. There were 74 (71.15%) males and 30 (28.85%) females. Sixty-four (61.54%) patients had bilateral club foot among them forty-four (42.31%) males and 20 (19.23%) were females. Among 40 (30.46%) patients with unilateral club foot deformity 30 (28.84%) were males and 10 (9.61%) were females. In 30 (28.84%) male patients with unilateral club foot 16 (15.38%) had right and 14 (13.46%) had left club foot deformity. There were 10 (9.61%) female patients with unilateral club foot deformity. Among them right foot was affected in 6 (5.77%) and left foot was affected in 4 (3.84%) patients. Family history of club foot was positive in 11 patients. Sixty-five (62.5%) patients belonged to lower, 37 (35.58%) middle and only 2 (1.92%) belonged to upper socio-economic class. There were 103 (99.03%) patients who born full term and only 1 (0.96%) patient born two weeks post-maturity. Seventy-three (70.19%) patients were born through spontaneous vertex presentation, 14 (13.46%) required caesarean section and 17 (16.34%) required episiotomy to facilitate their births. Considering birth order 48 (46.15%) were first, 12 (11.53%) were second, 17 (16.34%) were third, 7 (6.73%) were fourth, 14 (13.46%) were sixth, 5 (4.81%) were seventh and only 1 (0.96%) was fifteenth

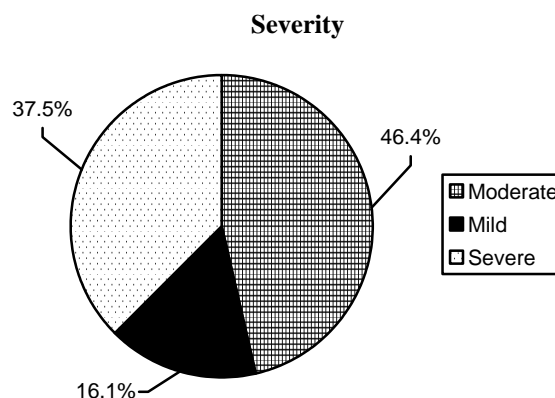


Graph # 1:

baby of the family. There were 2 (1.92%) twin patients both had bilateral club foot deformity. We also analyzed that among 168 club feet, 78 (46.42%) were mild, 27 (16.07%) were moderate and 63 (37.5%) were of severe variety. According to the severity, moderate type was statistically higher in this study, i.e. $p\text{-value} = 0.000 < 0.0001$. Seventy calves (41.66%) were normal and 89 (52.97%) were thin. There were 10 (9.61%) patients with associated anomalies in which three (2.88%) patients had congenital constriction bands, two were (1.92%) at the level of mid tibia and one was (0.96%) at the level of ankle joint. Two (1.92%) patients had pyloric stenosis, two (1.92%) had umbilical hernia, one had under developed foot with absent second, third and fourth rays, one had inguinal hernia and one had imperforate anus of low variety.



Graph # 2: $p\text{-value} = 0.000 < 0.0001$ (the proportion of club foot was significantly higher in First baby).



Graph # 3: According to the severity, moderate type was statistically higher in this study, i.e. $p\text{-value} = 0.000 < 0.0001$.

Discussion

Nand S 1964⁹ reported a series of 70 patients with age of presentation ranging between 4 weeks to 5 years. Hussain SA et al 2008¹⁰ reported a series 220 patients of club foot with age of presentation ranging from 6 weeks to 3 Years. In our study, the age of presentation for treatment ranged

from 1 – 52 weeks with a mean of 6.24 ± 1.32 weeks which is less than the previously reported series. It is due to awareness of the parents regarding benefits of the early treatment and availability of treatment facilities for club foot deformity.

Incidence of club foot deformity is different in males and females in different populations as reported by Wynne-Davis 1964 in a study of 635 patients from England reported male to female ratio of 2.17:1.¹¹ Yamamoto H 1979 and Morokawa 2001 reported male to female ratio of club foot 2:1 and 2.2:1 from Japan respectively.^{12,13} Male to female ratio in Sweden is 1.6:1 and in Texas it is 2:1.¹⁴⁻¹⁷ In a nationwide audit of management of club foot from Scotland male to female ratio of 2:5 was reported.¹⁸ In our study male to female ratio is 2.4:1. It is observed that club foot is more common in males. The preponderance of males for club foot deformity has been noted in this study which is comparable to other similar studies.

A significant number of patients with club foot deformity have positive family history which varies between various populations. In Caucasian population 24 – 30% patients have positive family history.^{15,19} It is reported that 2.9% patients with positive family history had club foot deformity as against 1.2 per 1000 live births in general population therefore; if the first baby was born with club foot deformity then the chances of club foot in the second baby are increased more than twenty times.¹¹ The prevalence of club foot deformity has been noted for boys and it is of interest to consider the male and female first degree relatives separately. It has also been observed that there is increased risk to the male relatives of a female patient. Females suffer the deformity only half as often as the males but her male relatives are far more frequently affected. The female relatives of the male patients seem very unlikely to acquire the deformity.¹¹ Cartledge I et al 1984 recorded positive family history in 54% Polynesian and 30% Caucasian children.¹⁹ From Aberdeen UK Miedzybrodzka Z recorded that 5.7% of males and 2.5% of females patients had positive family history in first degree relatives.²⁰ Hussain SA from NWFP Pakistan reported a series of club foot deformity with positive family history in 57.14% patients.¹⁰ In our study positive family history was recorded in 11% patients. It is due to genetic influences which dramatically increase the incidence of club foot deformity with positive family history in different populations therefore, they are considered as important etiological factors.²¹ Pre-maturity was considered as an etiological factor of club foot deformity in previously reported studies as Chesney DJ et al reported 10% patients with club foot deformity born prematurely with male to female ratio of 1.75:1.¹⁸ In our study, none of the patients was born prematurely and only one patient born two weeks post maturity therefore maturity is considered as insignificant factor in the etiology of club foot in this study.

Chesney DJ et al 2004 reported an audit of management of congenital talipes equinovarus from Scotland recorded mode of delivery among 198 infants and observed 123

(62.2%) spontaneous vertex deliveries, 38(19.2%) by caesarean section, 17 (8.2%) by forceps deliveries, 7 (3.5%) were delivered by ventouse method, and one(0.5%) was a breech delivery.¹⁸ Boo and Ong 1990 reported that more cases of club foot are delivered by the breech as compared to control nevertheless the vast majority of cases had a cephalic presentation.²² Cardy AH 2007 reported 81% patients of club foot deformity delivered with cephalic presentation, 2% with breech presentation and 17% with caesarean section.²³ In our study of 104 patients of club foot deformity seventy-three patients presented through spontaneous vertex delivery, 14 required caesarean section and 17 required episiotomy to facilitate their births. By comparing this factor with other studies mode of delivery is also insignificant factor in the etiology of club foot deformity in our study.

Majority of the patients of club foot deformity were first born babies of the family therefore seniority order is considered as one of the important etiological factor because intrauterine environmental factors, acting during sixth to eighth week of fetal life, have also been implicated in the causation of club foot^{11,24} and influence of the young primigravid uterus has been suggested by Palmer's findings²⁵ of younger mothers in a group of affected caucasian children with a negative family history of club foot. Wynne Davis R 1964 reported a series of 94 patients of club foot deformity and observed that among them 45 were first, 23 were second, 17 were third and 9 were fourth babies of the family. Chesney DJ 2004 reported that first born baby was affected more frequently than children born lower in birth order, since 46% of 204 children in whom birth order was documented were first born: 31% were second born.¹⁸ In our study of 104 patients with club foot deformity, considering birth order 48 (46.15%) were first, 12 (11.53%) were second, 17 (16.34%) were third, 7 (6.73%) were fourth, 14 (13.46%) were sixth, 5 (4.81%) were seventh and only 1 (0.96%) was fifteenth baby of the family. It is reported that first born children are more likely to have club foot than children from subsequent pregnancies.¹⁴ As in all previously reported series majority of patients were first born babies of the family therefore, crowding phenomena as an etiological factor of club foot cannot be denied.

Use of nutritional supplements containing folic acid three months before the first trimester of pregnancy was reported with reduced risk of club foot deformity by Cardy AH et al 2007.²³ It is also reported that both folic acid and multivitamins have been proven effective at reducing the risk of numerous other birth defects.²⁶ In our study of 104 patients with club foot deformity considering socioeconomic status 67 (39.88%) patients belonged to lower, 35 (33.65%) middle and only 2 (1.92%) belonged to upper socio-economic class. Therefore, it is quite convincing that, food supplements containing folic acid and multivitamins have a definitive role in the prevention of club foot deformity.

Idelberger's twin studies identified a monozygote concordance of 32.5% strongly suggesting a genetic influence

since dizygotic Macnocol twin concordance was only 2.9%.²⁷ Chersney DJ 2004 reported a series of 198 patients with club foot in which 8 (4%) were twins. In all twin cases only one sibling was affected.¹⁸ The Idelberger's monozygotic concordance in the causation of club foot deformity was not seen in Scottish cohort.¹⁸ Cartlidge I, 1983 presented a series of 238 cases of club foot and did not observe twins in his series.¹⁹ Cardy AH reported a series of 200 patients of club foot deformity with 10 twin (5%) pregnancies among them 9 were non identical.²³ In our study of 104 patients 2% of club foot deformity were twin and had bilateral club foot deformity.

Club foot deformity may be unilateral or bilateral. Cartlidge I, 1983 observed that bilateral club foot deformity was marginally less common than unilateral club feet. It was bilateral in 48 (41%) Polynesian of Auckland and in 59 (49%) Caucasian of Glasgow.¹⁹ Yamoamto H, 2002 in his study from Japan reported bilateral and unilateral case of club foot deformity in equal numbers.¹² Chesney D BMC, 2002 reported 45% bilateral and 55% unilateral club foot deformity in a study of 204 patients from UK.²⁸ Morokawa 2001 reported ratio of bilateral to unilateral involvement of club foot 1:1.2 from Japan.¹³ Hussain SA 2008 reported a series of 70 patients with club foot deformity from NWFP Pakistan among them 23 (32.8%) patients had bilateral and 47 (67.2%) had unilateral club foot deformity.¹⁰ From Scotland Chesney D 2004 in a study of 216 patient reported that 99 (45.7%) patients had bilateral and 117 (54.3%) had unilateral club foot deformity.¹⁸ Cardy AH 2007 reported 51% bilateral and 49% unilateral club foot deformity.²³ In our study of 104 patients with club foot deformity, sixty-four patients had bilateral and forty had unilateral club foot deformities.

In unilateral involvement of club foot deformity either right or left foot is affected as Cartlidge I, 1984 reported that in 70 patients with unilateral club foot deformity right foot was involved in 38 patients and left foot was involved in 32 patients in Polynesian children. He also reported a study of 120 Caucasian patients with club foot deformity from Glasgow and reported that 61 patients of unilateral club foot deformity 35 had right and 26 had left club foot deformity.¹⁹ Chesney D (2007) while reporting a series of 204 children with club foot deformity observed 112 children had unilateral involvement, among them, 51 had left sided and 61 had right sided involvement of the foot.²⁸ Morokawa 2001 in a study of 1215 patients of club foot deformity reported the ratio of right to left side involvement 1.8:1 from Japan. He also reported ratio of right side involvement to left side involvement 1.5:1 from Sweden.¹³

Chesney DJ 2004 reported in a study of 216 patients in which there was right sided involvement 52 and left side involvement in 65 patients.¹⁸ Cardy AH 2007 reported in unilateral there was more involvement of right foot than the left (48% of males, 55% of females). Females who were affected unilaterally were more than twice as likely to be affected on the right than the left, where as in males left and

right sides were equally affected (female 29% left, 71% right, males 48% left 52% right).²³ In our study of 104 patients with club foot deformity right side was affected in 30 patients and left side was affected in 10 patients. In our study involvement of right side is more than the left side as it is also evident in the findings of Cardy AH 2007.

Club foot deformity can be mild, moderate or severe. Severity of club feet is associated with thin calves due to retracting fibrosis of soft tissues distal to the knee joint. On one hand it does not allow normal growth of the calves and on the other hand cause shrinkage of the soft tissues. Ippolito and Ponseti 1980 documented the presence of increased fibrous tissues in muscles, fascia, ligaments and tendon sheaths and concluded that retracting fibrosis may be a primary etiological factor.²⁹ Cartlidge I, 1984 reported that no correlation was found between presence and absence of family history and severity of the club foot. However, bilateral cases were more severe than the unilateral.¹⁹ In our study of 104 patients with 168 club foot deformity considering severity of the deformity 78 feet were of mild, 27 were moderate and 63 (60.57%) were of severe variety and all the severe variety of club foot deformities had thin calves. Therefore, thin calves are index of severity of the club foot deformity.

Considering etiological theories of connective tissue hypothesis the primary abnormality of connective tissues is responsible for club foot deformity which is supported by the association of club foot with different anomalies.¹¹ In our study of 104 patients with club foot ten patients had associated anomalies. Among them three patients had congenital constriction bands, two were at the level of mid tibia and one was at the level of ankle joint, two patients had pyloric stenosis, two had umbilical hernia, one had under developed foot with absent second, third and fourth rays, one had inguinal hernia and one had imperforate anus of low variety. Congenital anomalies have a wide variation of expressions and all of them are related to connective tissue abnormalities which is also responsible for club foot deformity.

Conclusion

Incidence of club foot varies in different geographical distributions as different races are populated in different geographical distributions. Age of presentation of patients for treatment is less as compared to other series. Gender plays a definitive role in the etiology of club foot as incidence of club foot is higher in males. There is more number of patients with positive family history as genetic factors are involved in etiology of club foot. Mode of delivery has no significance in the etiology of club foot. As club foot is more common in first born patients crowding phenomena can be considered as an etiological factor. Dietary deficiencies can produce club foot deformity as it is more common in lower socioeconomic class. Laterality, side affected and thin calves were observed in one third of patients. Congenital anomalies had a wide variation of expressions and all of them are related to connective tissue abnormalities which is also

responsible for club foot deformity.

References

1. Macnicol MF. The management of club foot. *JBJS* 2003; 85-B (2): 167-70.
2. Herring JA. Tachdjian Paediatrics: Vol 3. In W.B Saunders Company 2002: 922-50.
3. Herzonburg JE, Carroll NC, Christofersen MR, et al. Club Foot analysis with the three dimensional computer modeling. *JPO*, 1999: 8-257.
4. Manaster BJ. Congenital foot anomalies. In hand book of skeletal radiology 1996: 338-49.
5. Ozonoff MB. The foot in Pediatric Orthopaedic Radiology 1992: 416-23.
6. Miedzybrodzka Z. Congenital Talipes equino-varus (club foot) a disorder of the foot but not the hand. *J Anat* 2003; 202 (1): 37-42.
7. Chesney D, Barker S, Miedzybrodzka Z, et al. Epidemiology and genetic theories. *Bull hosp Joint Dis*. 1999; 58 (1): 59-64.
8. Anand A and Sala DA. Club foot Etiology and Treatment. Review article. *Indian Journal of Orthopaedics* 2008; 42 (1): 22-8.
9. Nand S. A study of congenital talipes equino-varus Singapore Medical Journal 1964; 5 (4): 212-6.
10. Hussain SA, Khan MS, Ali MA, et al. Modified turco's postero-medial release for congenital talipes equinovarus. *J. Ayub Med. Coll. Abbotabad* 2008; 20 (3): 78-80.
11. Wynne-Davis R. Family studies and the cause of club foot. *JBJS* 1964; 46-B (3): 445-63.
12. Yamamoto H. A Clinical, genetic and epidemiological study of congenital club foot. *J. Hum. Genet.* 1979; 24 (1): 37-44.
13. Gen M, Hisater N and Rehnburg L. Epidemiology of congenital club foot in Japan and Sweden. *Journal of Japanese Orthopaedic Association* 2001; 10 (2): 198-205.
14. Moorthi RN, Hashmi SS, Langois P. Idiopathic talipes equinovarus in Texas *Am. J. Med. Genet* 2005; 132 A: 376-80.
15. Lochmiller CL, Johnson D, Scott A, et al. Genetic Epidemiology study of idiopathic talipes equinovarus. *Am J Med Genet* 1998; 79: 90-6.
16. Byron-Scott, Sharpe P, Hasler C, et al. A South Australian population based study of congenital talipes equinovarus. *Paediatric and Perinatal Epidemiology* 2005; 19: 227-37.
17. Carey M, Mylvaganam A, Rouse I, et al. Risk factors for isolated talipes equinovarus in Western Australia, 1980-1994. *Paediatric and Perinatal epidemiology* 2005; 19: 238-245.
18. Chesney DJ, Barker SL, Macnicol MF, et al. Management of Congenital Talipes Equinovarus in Scotland: A Nationwide Audit. *Surg J R Coll Surg Edinb Ire.* 2004; 47-51.
19. Cartlidge I. Observations on the epidemiology of club foot in Polynesian and Caucasian populations. *J. Med Gen.* 1984; 21: 290-2.
20. Miedzybrodzka Z, Chesney D, Barker S, et al. Genetic basis of idiopathic talipes equino-varus *Eur. J. Hum. Genet* 2000; 8 (SI): 70.
21. Club foot –Wikipedia The free encyclopedia <http://en.wikipedia.org/wiki/>.
22. Boo NY and Ong CL. Congenital talipes in Malaysian neonates. Incidence, pattern and associated factors. *Singapore Medical J* 1990; 31: 539-42.
23. Cardy AH, Barker S, Chesney D, et al. Pedigree analysis and epidemiological features of Idiopathic congenital Talipes Equinovarus in United Kingdom. *BMC Musculoskeletal disorders* 2007; 8: 62.
24. Turco VJ. Club Foot. New York Churchill Living stone 1981.
25. Palmer RM. The genetics of talipes equinovarus. *J Bone Joint Surg (Am)* 1964; 46: 542-56.
26. Texas Department of state Health Services Birth Defect Epidemiology and Surveillance Birth defect risk factor series; Talipes equinovarus (Club Foot) 2006: 1-5.
27. Idelberger K and Erginis D. Zwillingsforschung beim angeborenen Klumpfuß Verhondlungen der Deutschen Orthopaedischen Gesellschaft 1939; 33: 272-6.
28. Chesney D. Subjective and objective outcome in congenital club foot; a comparative study of 2004 children. *BMC Musculoskeletal Disorders* 2007; 8: 53.
29. Ippolito E, Ponseti IV. Congenital club foot in the human fetus. *J. Bone Joint Surg* 1980; 62: 8-21.