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Statement of Purpose

Study aims: 1) identify annual incidence of congenital clubfoot and associated comorbidities; 2) assess surgical symptomatic recurrence between idiopathic and non-idiopathic clubfoot; 3) determine associated variables related to symptomatic recurrence.

Introduction and Literature Review

Clubfoot is categorized as idiopathic or non-idiopathic when associated with neuromuscular conditions or syndromes, like spina bifida and arthrogyposis.¹ Non-idiopathic clubfoot incidence rate ranges from 13.5% - 30.5%, which tend to present as a stiffer deformity, historically treated with surgery.^{2,3} Ponseti casting averts idiopathic and non-idiopathic clubfoot from surgery, however recalcitrant clubfoot often requires subsequent surgical procedures.^{4,5}

Recurrence among idiopathic and non-idiopathic clubfoot differs due to parent education and systemic neuromuscular diseases.⁶ Gerlach et al demonstrated myelomeningocele associated clubfoot initially treated with Ponseti technique achieved the same correction as idiopathic clubfoot. However, myelomeningocele clubfoot proved a statistically significant greater relapse occurrence of 68%, with only 14% recalcitrant clubfoot that underwent additional surgeries.⁷ In contrast, Arkin et al reported similar initial non-idiopathic Ponseti correction results, but found a higher Spina bifida clubfoot surgical recurrence of 58% within three years that correlated with open versus percutaneous achilles tenotomies.⁸

Interestingly, Richards et al reported 9% of idiopathic clubfeet diagnosed before 3 months old, were indeed associated with a comorbidity, yet the underlying abnormality was identified between two to five years old.⁹ Due to gross and motor development, other comorbidities may not be observed at initial clubfoot presentation and correction, suggesting parents, podiatric or orthopedic surveillance for clubfoot recurrence.

This research furthers the comparative evaluation of non-idiopathic and idiopathic clubfoot conservative and surgical treatment outcomes.

Methods

The Kaiser Permanente Northern California (KPNC) database was searched for children who received a ICD9 clubfoot diagnosis from 2007-2015 at age of less than 3 years old from the orthopedic and podiatry departments with at least a three-year consecutive insurance membership. Twelve non-idiopathic diagnoses were identified and associated with clubfoot diagnoses codes. Surgical symptomatic recurrence was defined as additional surgical interventions after traditional Ponseti casting, extracted from operating room procedure codes. Initial Ponseti casting including an achilles tenotomy was performed for all patients prior to surgical intervention (Figure 1). Patients who underwent surgery were chart reviewed to determine average age for surgery, frequency of surgery, laterality recurrence, and types of procedures performed. Demographic data was correlated with clubfoot type and recurrence. Comparisons involving categorical variables were performed using the chi-square or Fisher's exact test. Normally distributed continuous variables were compared using Student's t test. All data analysis were conducted using SAS 9.4 (SAS Institute; Cary, NC).



Figure 1. Clubfoot before and after initial Ponseti serial manipulative casting.

Results

Kaiser Permanente Northern California Clubfoot Treatment 2007-2015

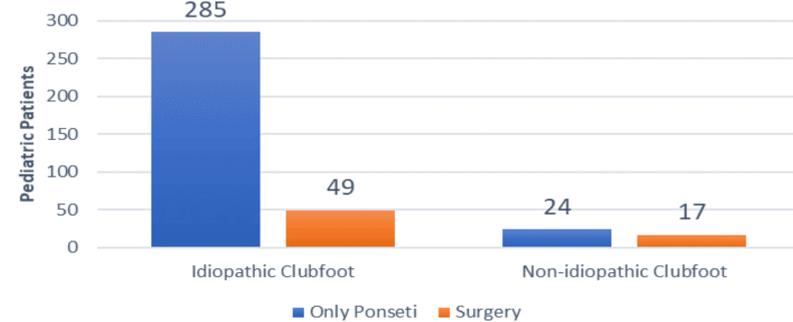


Figure 2. Idiopathic and non-idiopathic clubfoot treated with Ponseti casting and requiring additional surgery for symptomatic recurrence

Table 1. Surgical symptomatic clubfoot recurrence

	Idiopathic Clubfoot (N=49)	Non-idiopathic Clubfoot (N=17)	Average Age Idiopathic (yrs)	Average Age Non-idiopathic (yrs)	Unilateral (N=21)	Bilateral (N=45)
First Surgery	40 (82%)	11 (65%)	3.3	2.1	20 (95%)	31 (69%)
Second Surgery	6 (12%)	4 (24%)	5.6	5	1 (5%)	9 (20%)
Third Surgery	3 (6%)	2 (11%)	6.7	6	0	5 (11%)
	p=0.31		p=0.04, 0.74, 0.80		p=0.66	

Results Continued

NON-IDIOPATHIC CLUBFOOT COMORBIDITIES

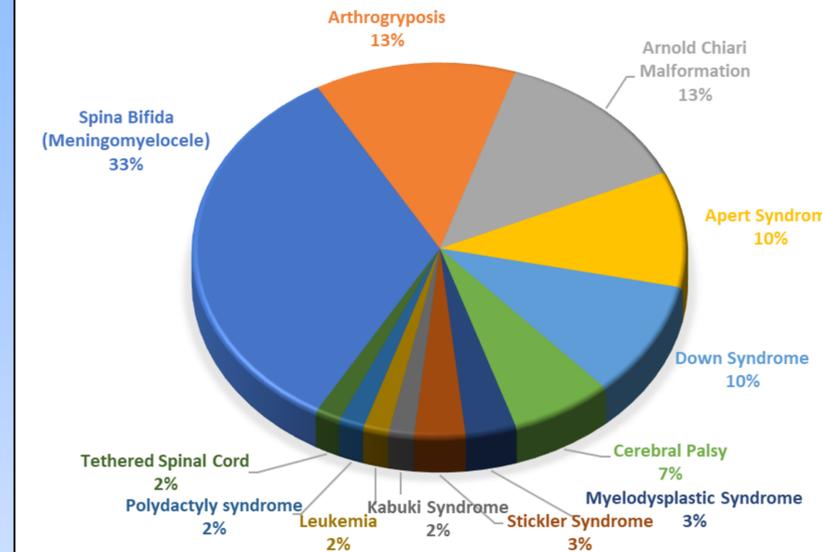


Figure 3. Comorbidities associated with non-idiopathic clubfoot.

- KPNC clubfoot incidence rate is 1 in 1000 live births
- 375 children received a ICD9 clubfoot diagnosis in 2007-2015 (Figure 2)
 - Even though idiopathic clubfoot was more common than non-idiopathic clubfoot, non-idiopathic clubfoot had a higher surgical intervention (41%) with statistical significance ($p=0.0001$).
- Twelve associated comorbidities were identified (Figure 3)
 - Spina bifida was the most common
 - Arthrogyposis and Arnold Chiari were the second most common
- Surgical symptomatic recurrence observed in 66 (17.6%) children
 - Overall clubfoot diagnoses (Table 1)
 - 51 children only needed one surgery
 - 10 children needed two surgeries
 - 5 children needed three surgeries
 - Idiopathic clubfoot symptomatic recurrence (N= 49 Pts, 74%)
 - Non-idiopathic clubfoot symptomatic recurrence (N= 17, 26%)
 - No statistical significance for surgical interventions between idiopathic and non-idiopathic clubfoot
 - Non-idiopathic clubfoot required surgery earlier at average age 2.1 years old, which was statistically significant ($p=0.04$). No significance between surgery ages between 2nd and 3rd surgeries for non-idiopathic and idiopathic clubfoot
- Repeat tendon achilles lengthening was often performed. The majority of Patients underwent a Anterior tibialis tendon transfer as their final procedure (Figure 4)
 - Anterior tibialis tendon transfer was the most common procedure performed between two to six years of old.
- No demographic statistically significant risk factors: age, gender, race, laterality

Results Continued

Clubfoot Surgeries for Symptomatic Recurrence

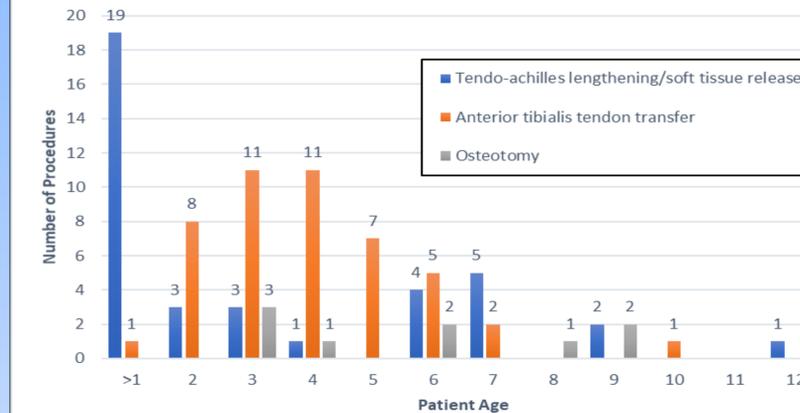


Figure 4. Types of clubfoot surgeries performed in relation to patient's age.

Conclusion

Ponseti serial manipulative casting is successful for idiopathic and non-idiopathic clubfoot. However, 17.6% of clubfoot patients required surgical intervention after initial Ponseti casting due to symptomatic recurrence. Non-idiopathic clubfoot had a statistically significant higher occurrence for surgical intervention and underwent surgery at a younger age compared to idiopathic clubfoot. A neuromuscular disorder in combination with the histopathology of a clubfoot deformity, may be a long lived driving force for a stiffer deformity driving surgical correction. Nevertheless, in our study the majority of non-idiopathic and idiopathic clubfoot were treated with Ponseti casting without recurrence; therefore Ponseti casting is the first line treatment and standard of care for any clubfoot presentation, in order to help minimize surgical correction requirements.

We hope this data guides parent education and clinician awareness for clubfoot recurrence necessitating surgical intervention and long term surveillance.

References

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