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Case Report

Pes Equinus in Healthy Children and Adolescents

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Abstract

Background: Pes equinus is associated with various pathologies and, generally speaking, appears frequently in healthy children and adolescents. The object of this study is to diagnose and treat pes equinus and, where possible, any associated pathologies.

Methods: In a prospective study over a period of 10 months, 100 children or adolescents were examined and reviewed. The associated pathologies were multiple, usual or unexpected and sometimes associated: Calcaneus Apophysitis and Achille pain (42 cases), Idiopathic Toe Walking (22 cases), flexible flat feet (13 cases), chronic ankle instability and acute ankle sprains (12 cases), Hallux Valgus (8 cases), forefoot pain (7 cases). Associations are possible.

Results: The equinus treated orthopedically (96 cases) or surgically (4 cases) steadily disappeared. The results of the treatment of the associated pathologies showed 56 healings, 16 improvements, 8 non improvements, 12 cases of insufficient follow-up, 11 cases were operated on or are going to be operated.

Conclusion: In this cohort of 100 healthy children and adolescents, diagnosis and treatment resulted in healing in all cases of pes equinus as well as, in 72% of the cases, the healing or improvement of the associated pathologies.

Keywords: Pes Equinus; Calcaneus Apophysitis; Idiopathic Toe Walking; Flexible Flat Feet; Chronic Ankle Instability; Hallux Valgus; Metatarsalgia

Introduction

Pes equinus, or rather the tightness of the gastrocnemius muscles, is easy to diagnose when one is looking for it and is common amongst healthy children and adolescents, often associated with other common, or less common or unexpected, pathologies.

The object of this study, conducted by a professional paediatric orthopaedics practitioner over a short, but significative, period is to answer to the following two questions:

1. Within current paediatric orthopaedic practice, what are the pathologies associated with pes equinus in healthy children and and adolescents?
2. Can the treatment of pes equinus improve the associated pathologies which, as a whole, are due to compensatory pain patterns?

Patients and Methods

Patients

A prospective study over a 10-month period, conducted between October 2021 and July 2022, where 100 successive cases of healthy children and adolescents were diagnosed with a 15° to 60°equinus and re-examined later on. The research of pes equinus is detailed at “Equinus Method of Evaluation”.

Patients suffering from neurological diseases, foot malformation or affected by the autism spectrum, as well as 16 children and

adolescents exhibiting a pes equinus lost to follow-up, have been excluded from this study. The 100 children and adolescents that were re-examined exhibited a number of pathologies:

- Calcaneus Apophysitis (Sever disease) (38 cases) or pain in the Achilles' heel or calves (4 cases). There were no exclusions made during the study period, which confirms that all patients seen between October 2021 and July 2022 all had pes equinus
- Bilateral Idiopathic Toe Walking (22 cases). Excluding children under the age of 5 years old, there were no exclusions during the study period
- Static flat feet (13 cases). Concerned children with an average age of 10 years and 1 month (ranging from 5 to 15 years old) with Type 2 or 3 flat feet. Only those children suffering from pes equinus were included in the study period
- Chronic ankle instability (9 cases), including a case of instability in the subtalar joint. No exclusions took place during the study period
- Acute ankle sprains (3 cases). During the study period, other acute sprains did not indicate the presence of an equinus. Diagnosis of an equinus can only be conducted on the non-traumatic ankle
- Hallux Valgus (8 cases). There were no exclusions during the study period, with all patients suffering from a hallux valgus being diagnosed with an equinus
- Köhler-Mouchet disease (2 cases). No exclusions took place during the study period
- Metatarsalgia (7 cases). No exclusions took place during the study period and including:
  - Freiberg disease affecting the second metatarsal (3 cases)
  - Central metatarsal pain (2 cases)
  - Pain in the internal sesamoid bone of the hallux (pseudo Renander) without visible radiological necrosis (2 cases)
- Different associations were observed (6 cases):
  - Calcaneus apophysitis and idiopathic toe walking (3 cases)
  - Calcaneus apophysitis and flat feet (2 cases)
  - Idiopathic toe walking and pains in the forefoot (1 case)

The study encompasses 56 male patients and 44 female patients. The average age was 12 years and 1 month with the youngest being 5 years old and the oldest being 18 years old.

Equinus: Method of Evaluation

Pes equinus, or rather the gastrocnemius tightness, is diagnosed in our study with the knee extended and by negating with a slight calcaneal varus the collapse of the valgus of the weight-bearing foot [1,2]. This calcaneus valgus is more or less important depending on the mobility of the subtalar joint and thus, is variable from one subject to another. The tightness of the soleus muscle during the flexion of the knee was sought out seldomly in this study but when it was, it was in most cases absent [3].

Equinus: Treatment

In 96 cases, conservative treatment of the equinus, consisting only of self-stretching of the calf muscles, positioned against a wall with knees extended and heels on the ground to be conducted for one minute, three times a day, was utilised. The 96 children and adolescents that were re-examined one month later (85 cases) or, for those that hadn't understood the process properly, two months later (11 cases).

In 4 cases of idiopathic toe walking, a bilateral elongation of the Achilles' tendons, due to a 50°or more equinus, was immediately carried out using White's sliding lengthening of the heel cord technic in a strictly percutaneously fashion using only two incisions, without sutures, on a section of the internal 2/3 of the Achilles' tendon at its calcaneal insertion and the posterior 2/3 4 cm above [4]. This non-abrupt and tactile elongation was often supplemented with a section of an outer cord of the tendon and/or the inner cord of the plantar muscle. The elongation, rarely exceeding a centimetre, was palpable under the skin and avoided tears and hypercorrections. The two below the knee resin casts, which allowed an immediate resumption of weight-support and walking. They were removed after five weeks. Self-rehabilitation took place a week later, making use of the active plantar flexion of the feet, with the weight of the body partially supported by the patient's hands using a prop, such as a table and then forgoing the prop fifteen days later.

Results

Results on the Equinus

Conservative treatment (96 cases): Equinus of 15° (minimum) and 40° (maximum), with a 30° average, treated only with self-stretching completely disappeared within a month in 85 cases and, for 11 cases, in two months.

Surgical treatment (4 cases): The four children afflicted idiopathic toe walking with an equinus of less than 50° became plantigrades with positive dorsiflexion two months after the removal of the resin casts.

Results on the Different Associated Pathologies

In this study, the treatment of the equinus, using either the conservative or surgical methods, was the only treatment used to treat the associated pathology, excluding the cases of hallux valgus and Freiberg disease which require surgical intervention.

- Calcaneus apophysitis/Sever disease (38 cases) and pain in the Achilles tendons and calves (4 cases): In addition to the equinus being corrected, the talalgia and pain in the Achilles tendons and calves disappeared within a month in 34 cases and in two months in 8 cases. Stretching was coupled with cessation of sport activities for a period that ranged from 15 days to a month depending on the case. No cases were excluded from this study
- Bilateral idiopathic toe walking (22 cases): Following self-stretching: Plantigrade walking in 7 cases, improvement in 8 cases, no improvement in 3 cases (treatment still in progress after two months). No cases were excluded from this study. Following surgical elongation: The four children were all plantigrades within two months of removing the resin casts
- Static flat feet (13 cases): Static flat feet only relate to children that had an equinus. The disappearance of the equinus, which was achieved in all cases, was a necessary prerequisite. Despite insufficient follow-up data, it has been observed normalisation in 2 cases, the plantar arch showed improvements in 6 cases and no improvements were noticed in 4 cases. No foot surgery was made in this study. Follow-up consultations took place six months later and the initial results are encouraging
- Ankle sprains (12 cases): Patients diagnosed with chronic ankle instability during the study period (8 cases) all had their equinus disappear within one or two months. 5 cases had a negative varus stress test result whilst the other three cases did not undertake a varus stress test. No cases were excluded from this study. Initial results, reviewed at least a month after the disappearance of the equinus, do not indicate any recurrence of sprains apart from a single case of subtalar instability, where a relapse did occur. Biannual follow-up consultations are in progress. Following the painful inflammatory phase, stretching remedied the equinus in the 3 cases of acute sprains
- Hallux Valgus (8 cases): No cases were excluded during the study period. The equinus were remedied in all cases by the end of the month needed prior to any surgical treatment. In 5 cases, surgical treatment was carried out, or is scheduled to be carried out. Given the initial self-stretching treatment, no surgical intervention is necessary concerning the calves' muscles.
- Other rare pathologies: No cases were excluded during the study period. Köhler-Mouchet disease: Disappearance of tarsal scaphoid tenderness occurred in both cases. Freiberg disease: Both cases that were surgically operated on are no longer suffering pain, as well as the two cases suffering from pain in the forefoot. The third case of Freiberg disease saw improvement following stretching and is now awaiting possible surgical intervention. The 2 cases of pain in the internal sesamoid bone (pseudo Renander): one case was cured and persistent pain continues in the other (Table 1)

	CASES	HEALING	IMPROVEMENT	NO IMPROVEMENT	OPERATED	NOT SUFFICIENT EXPERTISE
Sever disease	38	38	-	-	-	-
Achilles and Calf pain	4	4	-	-	-	-
Idiopathic Toe Walking	22	7	8	3	4	-
Flat feet	13	2	7	4	-	-
Ankle sprain	12	-	-	-	-	12
Hallux Valgus	8	-	-	-	5	3
Köhler disease	2	2	-	-	-	-
Metatarsalgia	7	3	1	1	2	-
TOTAL dont 6 associations	106	56	16	8	11	15

Table 1: Rare pathologies and their patient details.

Conclusion of Results

By only treating the equinus, the associated pathology was cured in 56 cases and improvements were observed in 16 cases. No improvements occurred in 8 cases. Follow-up data is insufficient for the 12 cases of ankle sprains (chronic and acute) and the 3 cases of hallux vagus have not had any surgical interventions yet. 11 cases have had, or plan to have, surgery performed upon them.

Discussion

This study, whilst consisting of 100 cases, is representative of observations that have been made over many years. It should be noted that the equinus in the 100 cases of this study was not found in 10 successive cases of Osgood-Schlatter disease where the responsible muscle is the quadriceps femoris and not the gastrocnemius muscle.

Conservative treatment by simple self-stretching (for the duration of one minute, three times a day), already advocated by Micheli, et al., without any physical therapy, cured the equinus within one to two months [5]. The surgical elongation of the Achilles tendons has the advantage of not leaving any scarring and, since it is distal, it can also encompass the soleus muscle, though the latter is rarely retracted. Finally, as stated by Barouk: "The more distal the elongation, the more the gain in dorsal flexion of the ankle is important [6]. The 38 cases of calcaneus apophysitis in this study were cured using simple self-stretching exercises. The causal link between pes equinus and calcaneus apophysitis seems established, as at Micheli, et al., [5]. This equinus is not found, curiously, within the works of McSweeney, et al., whose research methods are different [7]. Three treatments were suggested by Wiegerinck, et al., with identical results after a follow-up three months later [8]. In essence, "wait and see" versus lifting the Achilles heel versus physiotherapy. Self-stretching is not mentioned at all. The causal link also seems evident with the idiopathic toe walking, but the treatments suggested are very different: Williams, et al., show a lack of consensus in how to treat this affliction [9]. Thielemann, et al., propose a treatment consisting in using successive casts and after six months, no significant differences were observed between the Idiopathic Toe Walking (ITW) group and the group consisting of healthy children [10]. McMulkin, et al., followed a group of eight children that had undertaken surgery and observed that after one year and then five years, of follow-up consultations, the results were same [11]. Westberry, et al., believe that children with severe ITW, or those who didn't respond to conservative treatment, may draw benefits from have surgery performed upon them [12]. Treating the equinus seems all the more important that, according to Linsay, et al., 45 patients suffering from an equinus showed that the PROMIS (Patient-Reported Outcomes Measurement Information System) score revealed bad mobility and relationship between peers [13]. Investigating the possible presence of an equinus is part of the clinical examination for flexible pes planovalgus, notably in children whose plantar arch does not improve with time. Seringe, et al., describe flat feet with elastic in the calcaneus block but with a hypoextensibility of the triceps [14]. DiGiovanni, et al., suggest that there is reason to believe that there exists a link between equinus and the development of flat feet [15]. Kim, et al., demonstrated, in a study involving 97 patients, that there was an improvement in the bone alignment of flexible pes planovalgus after tendo-Achilles lenghtening, which was done using surgery [16]. The disappearance of the equinus, which was obtained in all the cases in our study using self-stretching, would

appear to be a necessity in order to correct flexible pes planovalgus in children and adolescents. With regards to chronic ankle instability, all cases involved in this study showed the presence of an equinus, which could explain why the ankle was unstable (much like if you were wearing high heeled shoes) and could bring on potential trauma to the patient as a result. Owoeye, et al., suggest using neuromuscular warm-up exercises, such as stretching, to avoid ankle sprains in young people playing football and basketball [17]. Short gastrocnemius muscles would be the cause of ankle instability in adults according to Machado, et al., [18.] In 8 cases of chronic ankle instability in our study, these were treated using stretching exercises and, despite not having enough follow-up data, there has not been any relapses observed thus far. Metatarsalgia in adults is often associated with pes equinus. DiGiovanni, et al., observed that the maximum dorsiflexion of the knee when extended was less than that observed in patients that exhibited symptoms in the forefoot and/or midfoot [19]. Morales-Munoez, et al., in his study involving 72 cases, suggested that treatment should be an elongation of the gastrocnemius muscles [20]. Metatarslgia in children appears to been much less documented. In our study, no surgical treatment was proposed to elongate the gastrocnemius muscles. Equinus found in the hallux valgus had already been observed in adolescents by Barouk whose 108 patients in his study had Scarf osteotomy surgical interventions but also a proximal release of the gastrocnemius muscles as part of that procedure [6]. According to the author, the retraction of the gastrocnemius muscles may have been responsible for excessive strain on the plantar fascia, notably on the thicker medial, thus causing an aggravation in the deviation of the hallux. Our study indicates using self-stretching to remove the equinus prior to any surgical intervention.

Conclusion

This short study, deliberately limited to 100 healthy children and adolescents, allows us to give answers to the following two hypotheses:

1. In current child orthopaedic practices, we can identify 15 pathologies associated with a pes equinus, which can either be painful or compensatory. These are discussed within the above sections
2. The treatment of the equinus was enough to completely cure 56 cases and observe an improvement in another 16 cases. No improvement was observed in 8 cases. Follow-up data is insufficient for the 12 cases of ankle sprain (chronic and acute) and the 3 cases of hallux valgus to yet be operated on. 11 other cases were operated on or are scheduled to be operated on

Using stretching exercises for neuromuscular warm-up to avoid ankle sprains amongst young people playing football or basketball is of great interest and would also help avoid incidents of calcaneus apophysitis or certain types of metatarsalgia.

Conflict of Interest

The author has no conflict of interest to declare.

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