

Flat Top Talus in the Bot Foot Congenital Idiopathic Equine Varus

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1. Abstract

1.1. Objectives: Detect the occurrence of flat top talus on early radiographs, show the acquired character of flat top talus and determine the risk factors associated with its occurrence.

1.2. Patients and Methods: This is an analytical and retrospective study conducted in the orthopedics' department of Catholic University of Louvain.

1.3. Results: 92 had met our inclusion criteria. We counted 124 cases of clubfoot including 31 cases of small dome, 56 cases of normal dome and 37 cases of flat top talus. Grade 3, according to the Dimeglio scoring system, was mainly represented within the three groups. But the severity of the grade did not significantly influence the distribution of the three groups. No significant differences were found in the distribution of the three groups when R1 or angle A was considered. We found a significantly high number of flat top talus in the group of the feet with tenotomy or invasive surgery compared to the group of feet that did not have the same surgery.

1.4. Conclusion: Our study confirms the hypothesis of the acquired character of the flat top talus. But better than confirming this hypothesis, our study specifies that surgery, whether minor or invasive, could be an etiology of the flat top talus if not a factor influencing its occurrence.

2. Introduction

The flat top talus is the Anglo-Saxon name for the flattening of the talar dome [1]. It is about a deformation known since many years [2] but there are very few studies relative to his etiology and to the risk responsible of his occurrence [1]. But we know this deformation is not always without disadvantages on ankle long lasting prognosis with risk of osteoarthritis occurrence [3]. It seemed ap-

propriate to us to perform this study with those targets:

- Determined on early x-ray, criteria of screening for the flat top talus occurrence.
- Look for a relationship between the flat top talus and the severity of the congenital idiopathic clubfoot.
- Verify the hypothesis for the acquired character of the flat top talus.

3. Materials and Methods

It is about an analytical and retrospective study performed in the orthopedic department of Saint Luc Clinical universities of Louvain (Belgium) over a period of 16 years from 1st January 2002 to the 1st January 2018. Were included in this study all the children support for a congenital idiopathic clubfoot varus equinus during this study period. Our inclusion criteria were: a regular monitoring since the birth until the age of 7, the existence of x-ray strict profile with the ankle in maximum dorsal flexion for children under 2 years and at charge for children over 2 years. Our exclusion criteria were: the transitional foot and other causes of Talipes equinovarus. Our methodology was the following:

- First, we identify all the monitoring children for a congenital clubfoot in the medical software explorer
- Basing on our inclusion criteria, a group of children were selected
- In this group of selected children, we counted the number of club-foot found which constituted our study population
- To quantify the flat top talus, we used the flattening index R/L defined by Hjelmstedt and Sahlstedt [4].
- The sample was subdivided in three groups based on the studies of Alexander Kolb and associates [5]: the feet group with flat top talus, the feet group with a normal dome and the feet group with

a little dome.

-We continued by looking for a correlation between the flat top talus and different settings to establish his risks factors

- For the quantification of the flat top talus, we used the flattening index R/L with R as the curvature radius of the talar dome and L , the length of the talus. Indeed, Hjelmstedt et Sahlstedt [4] assimilated the talar dome to an hemisphere which radius could be measured with Mose's concentric circles (Figure 1) which was the case in our study. As to the length L , she matched to the distance going from the posterior process of the talus except from the trine bone passing by the middle of his head to the intersection with the articular surface in the talonavicular joint. Those measures were done on 7 years old patients x-rays because at this age, the talar dome flattening is more evident.

-We shared our samples in three groups (Figure 2) based on Alexander Kolb and associates studies [5] : the feet group with a flat top talus (where the R_2 was superior to 0,42) with a very short talus but a very big curvature, the one with feet having normal dome(where the R_2 report was in between 0.33 and 0.42) and the feet group with a little dome (where the R_2 report was inferior to 0.33) with a short talus and a little radius curvature.

3.1. Measures Done on Early x-rays (6 Months Until 4 Years)

These measures were: The height H_1 and H_2 , the report R_1 and the angle A

-The height H_1 of the talus head correspond to the line segment passing through the most elevated point and low point of the articular surface of the talus, in the talonavicular articulation (Figure 3)

-The height H_2 of the talar dome correspond to the line length passing through the most elevated point and the lower point of the talar dome on the x-ray profile (Figure 3)

-The angle A is made by the line passing by the most elevated part of the body and the most elevated point of the talus head and the line passing by the lower point of the body and the lower point of the talus head (Figure 4)

3.2. Complementary Measures Taken on Late x-ray at Ages 5, 6 and 7

These measures were realized according to Pinto and associate's criteria [6]

-The height of the talar dome (Figure 5)

1. Identify the vertex of the lateral process of the talus (point 1)
2. Draw a straight line parallel to the ground, tangential to this point (straight line 2);
3. From the point 1, draw a straight line perpendicular to the straight line 2 (straight-line 3), till the intersection with the articular surface with the talar dome (point 4);
4. The height H_2 of the talar dome is given by the length of the line segment joining points 1 and 4

Ces mesures ont été réalisées selon les critères de Pinto et collaborateurs [6]

3.3. Height H_1 and the Length of the Talus (Figure 6)

1. Identify the highest point (point 1) and the lower point (point 2) of the astragalus articular surface, in the talonavicular articulation, on the lateral view x-ray;

2. Draw a line joining points 1 and 2 (straight line 3) matching to the height H_1 of the talus head;

3. Identify the middle of the line 3 (point 4);

4. Identify the most posterior point of the posterior point of the talus, excluding the trigone bone (point 5);

5. Draw a straight line (straight line 6) of the point 5, passing through the point 4 till the intersection with the articular surface of the talus, in the talonavicular articulation (point 7)

6. The distance in between the points 5 and 7 is the talus length L .

The link between R_1 and the angle A (Figure 7) was done and compared between different groups at this age.

All the measurements were performed by two orthopedic assistants and an experienced orthopedic in order to exclude the inter observational variability effect. The statistical analyses were performed using a SPSS software (SPSS statistics version 22.0TM, BMP Corp, Armonyk, NY, Etats Unis). Variance analyzes models (ANOVA) were used to compare continuous variables in between the 3 groups of clubfoot (flat top talus, normal dome and little dome) with Bonferroni test. Values of $p < 0,05$ were considered as statistically significant

4. Results

We collected a total of 187 children during our study period. Among the 187 children, 92 matched to our inclusion criteria be 49 %. In 60 children, (65 %) the effect was unilateral and was bilateral in 34 (35 %), be a study population of 124 varus equinus clubfeet. The sex rate was about 60 boys for 32 girls. The grade of clubfoot the most represented is the type 3 according to the Dimeglio score [7] with 88 cases (71 %) and the next was the type 2 found in 28 cases (14.5 %). The talar dome was "normal" in 56 feet (45.2%), and in 31 feet (25%), the talar dome was judged "little" whereas the "flop talus" was found in 37 feet be a 29.8% of cases.

In the feet group with a flat top talus, 26 (20.9%) were of grade 3 and 9, (7.26%) of grade 2. The grade 3 according to the Dimeglio score was therefore predominant between the three groups, but the clubfoot severity didn't significantly influence in the distribution of the three groups ($p = 0.518$). For 52 (42 %) feet, no tenotomy was performed including 17 (13.7%) for the normal dome group, 22 (17.7%) for the little dome group and 13 (10.7%) for the flat top talus group. The tenotomy was performed in 68 cases, be in 54.8 % and the other type of surgery in 32 cases, either in 25.8 % (Figure 8).

For feet where no surgical intervention was performed, they were 35 (28.2 %) in the patients group with normal dome talus, 20 (16.2 %) in the small dome group and 18 (14.5 %) in the group of those showing a flat top talus.

No significant difference was found in the three-group dispatching (Figure 9), when we took in consideration the report R1 ($p = 0.59$)

About the angle A, no correlation was found in between the three groups ($p \geq 0.05$) (Figure 10).

With the angle A, we found a difference in the three groups dispatching, but this difference wasn't significant ($p = 0.552$) however old were the children.

We remarked a significantly higher number of flat top talus in children who benefited of a tenotomy (Figure 11) compared to those who did not ($p = 0.037$).

We remarked a mostly high number of flat top talus in the group of children who benefited of an invasive surgery (Figure 12) compared to those who did not have the same interventions ($p = 0.028$).

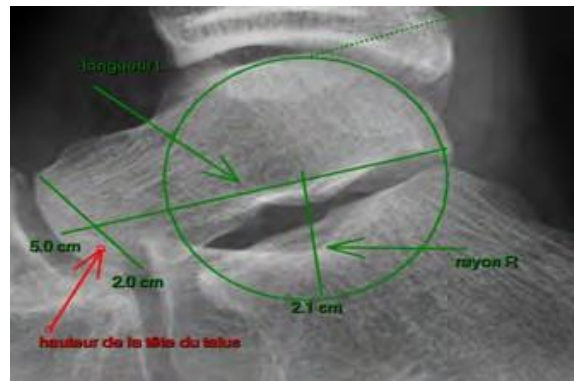


Figure 1: Figure showing the measurement of the flattening index R/L



Figure 2: Pictures showing différents groups

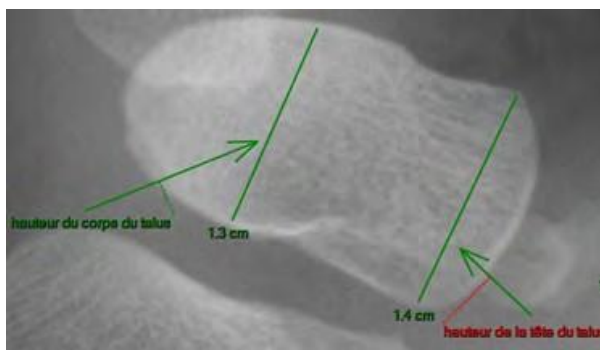


Figure 3: Image showing the measurement of heights H1 and H2 at the early time

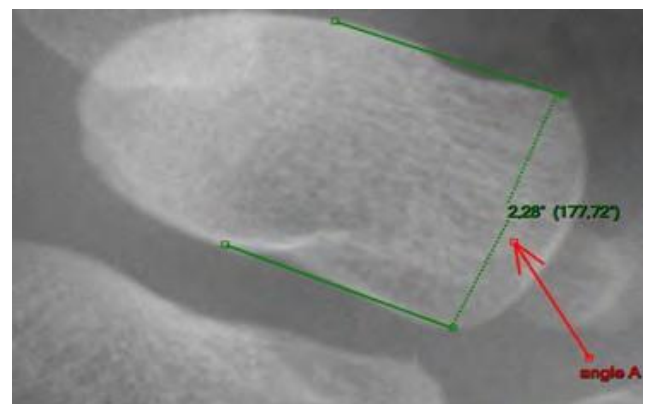


Figure 4: Image showing the measurement of angle A at early time

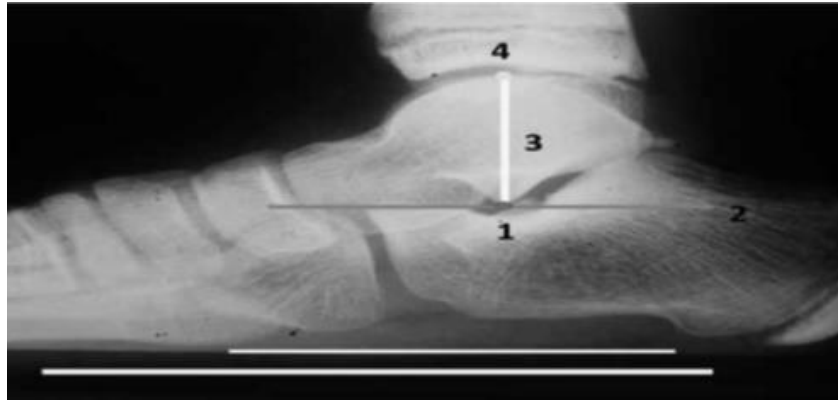


Figure 5: Image showing the calculation of the height H2 at the late time

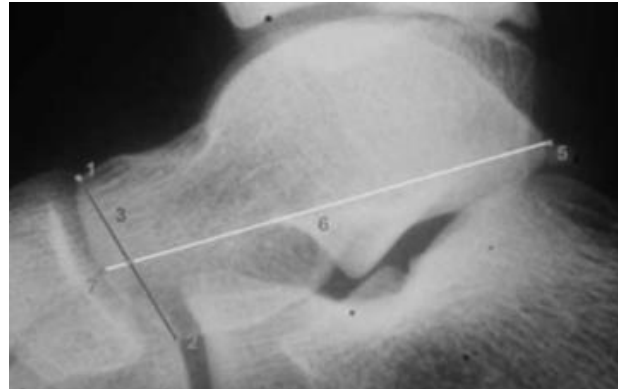


Figure 6: Picture showing a late calculation of the height H1 and of the length L of the talus



Figure 7: Measure of the angle A on late x-ray

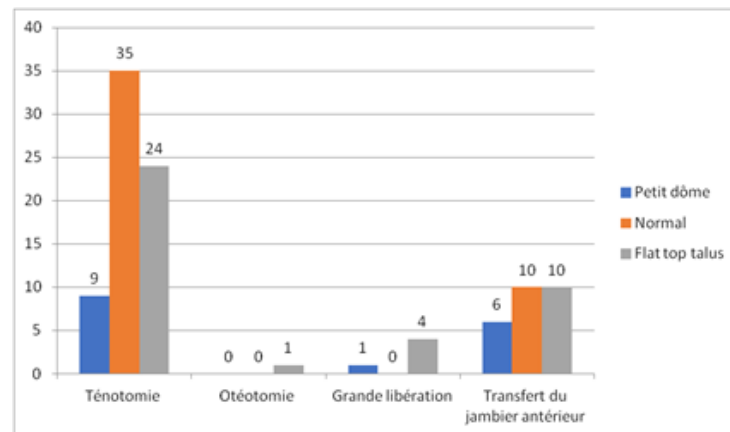


Figure 8: Dispatching of the workforce within different groups depending on the surgical intervention type

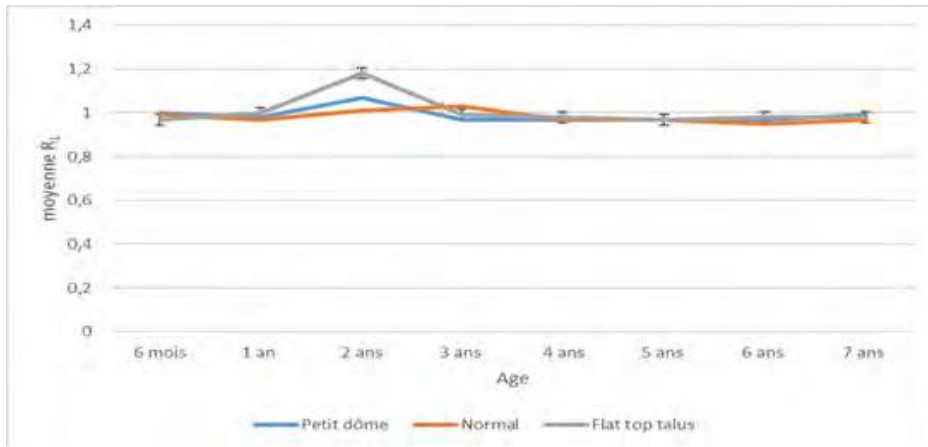


Figure 9: Dispatching of the R1 average rapport depending on the patients age and the group studied.

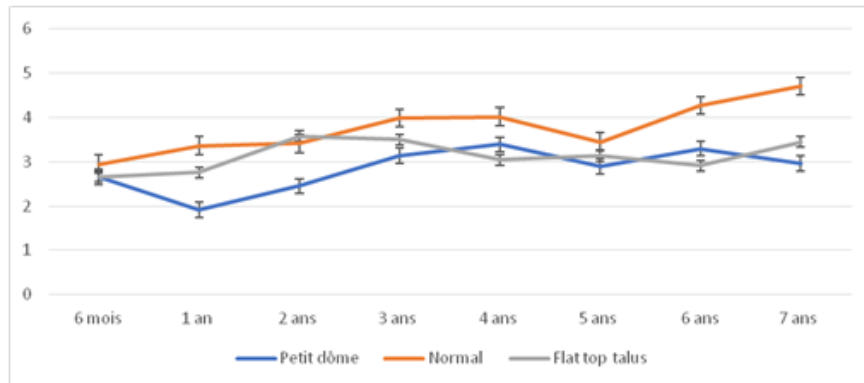


Figure 10: Distribution of the mean of angle A according to the age of patients and study groups.

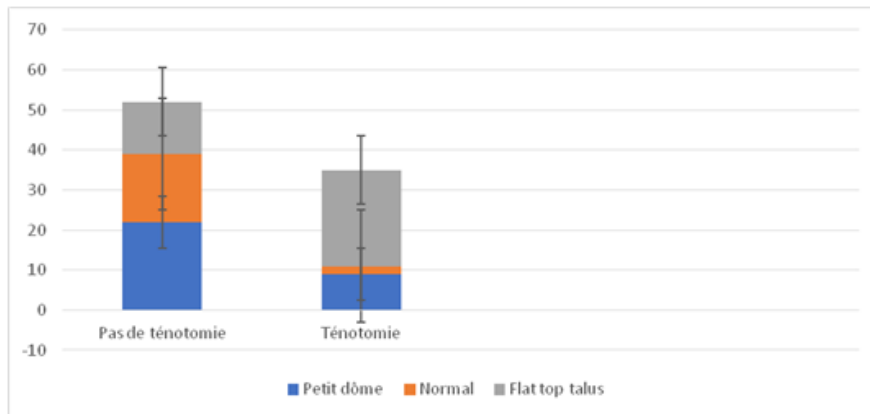


Figure 11: Dispatching of the differents groups workforce depending on the achievement or not of the tenotomy

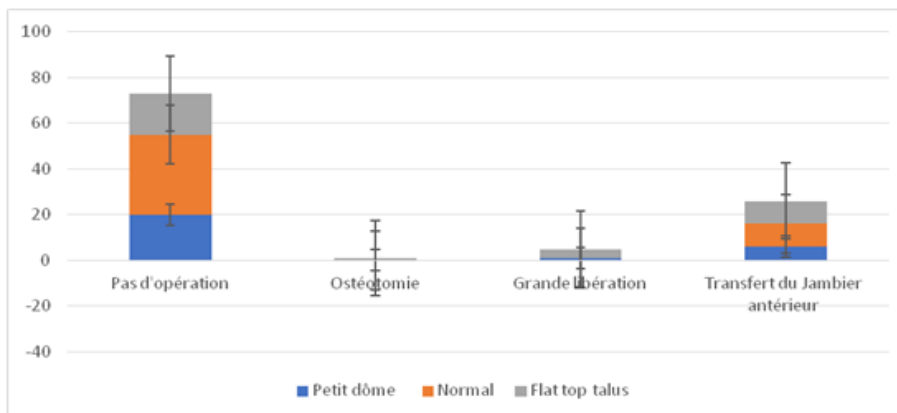


Figure 12: Dispatching of the differents groups workshop depending on the type of surgery

5. Discussion

The classification of Dunn and associates [1] were not based on the morphological aspect showing the flattening and the incongruity of the talus bone. But this classification isn't principally based on R / L ratios. Using Kolb and associate's classification, we found 29.8 % cases of flat top talus In our study. Pinto and associates with similar criteria found 12 cases of flat top talus on 14 patients studied [6], such a coincidence seemed to us too high compared to the usual incidence found in the literature: 27-74 % [8,9].

The analysis of our statistical values showed that it wasn't possible to predict on early x-rays the occurrence of the flat top talus by our defined radiological criteria and this could be related to the very slow ossification of the talar dome. Our results also shows that the flat top talus wasn't related with the congenital clubfoot severity and this is found in Kalenderer and associates' study where no clinic-radiological correlation was observed with the flat top talus. Our study confirms the assumption of the acquired character of the flat top talus because this deformation isn't seen on early x-ray but adding to this the anatomical dissection of clubfeet in fetus didn't highlight such a malformation [11].

But better than this confirmation, our study precise that the surgery could be actually an etiology of the flat top talus otherwise an influencing factor of his occurrence whether minor or invasive as report by some authors [12]. This is all the more consistent in Pinto and associate's study [6], a study consecrated to clubfeet all operated, they found 92.8 % of flat top talus. So it would be the forced dorsiflexion following the Achilles tenotomy that leas by an excess of pressure to the talar flattening. This lift a corner of the veil at the question without answer till then which is to know if the talus deformation is the result of the pressure applied during the correction process due to the initial surgery fix [5]. Nevertheless, we can't exclude the treatment effect according to Ponseti on the talar dome [13].

Our study has limits as the limited number of defined x-ray criteria.

6. Conclusion

Our study confirms therefore the hypothesis of the acquired character of the flat top talus and precise that his occurrence is related with the surgery even minor or invasive.

Our study retains its originality, for having been one of the first to study the possibility of the prediction of the flat top talus in the congenital clubfoot an to be able to comfort the acquired character hypothesis of the flat top talus.

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