What Should Be the Determinant of Treatment for Juveniles with Flexible Flatfeet?

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Abstract

Background: It is still controversial that if juveniles with flexible flatfeet need to be treated. Some believed they did not need the treatment unless they felt pain after exercise. However, as living standards rise, the amount of exercise among teenagers is declining. The juveniles with flexible flatfeet don't feel pain not because they don't have symptoms, but because they rarely walk. This study recruited juveniles with flexible flatfoot to find out if there was other determinant of treatment.

Methods: We recruited an experimental group with 20 severe flexible flatfeet and a control group with 20 severe flexible flatfeet. The contact area and load rate were measured separately. Then the subjects of experimental group were treated by exercise therapy for 8 weeks, and the plantar pressure data were measured again. The repeated measure was used to analyze the data.

Results: The contact area and load rate of mid foot decreased significantly in experimental group after 8-week treatment. All the subjects of experimental group did not feel any uncomfortable during the treatment. While the two kinds of data in control group were not changed much between pre-after measurements.

Conclusion: Exercise therapy could effectively improve the severe flexible flatfoot. If the juveniles with flexible flatfoot need the treatment should not depend on the symptoms only, but also on the severity. The juveniles with severe flexible flatfoot should be treated as soon as diagnosed.

Introduction

Flexible flatfoot is common in juveniles ¹. However, if the juveniles with flexible flatfeet need to be treated is still controversial. Some scholars believed that teenagers were growing and developing, they did not need the additional treatment ² and the flexible flatfoot normally disappeared during growth ³. While others considered that they still needed to be treated if they felt pain ⁴ after walking or other exercise ⁵.

Flexible flatfoot means when the foot bears weight, the medial longitudinal arch is missing and the structure of the foot is deformed, while, when the foot does not bear weight, the arch is still present like the normal foot ⁶. In this case, whether flexible flatfoot needs the treatment commonly depends on the symptoms of the foot after walking or exercising ⁷. However, as living standards rise, the amount of exercise among teenagers is declining. That means the juveniles with flexible flatfoot don't feel tired or pain not because they don't have symptoms, but because they rarely walk. Therefore, if juveniles with flexible flatfoot need the treatment may not merely depend on the symptoms.

In this study, we recruited 2 groups of severe flexible flatfeet among juveniles. One was experimental group in which the subjects were treated for 8 weeks, the other was control group. The plantar pressure data were measured and recorded separately. After 8-week treatment, we measured the data of 2 groups again to find out if juveniles with severe flexible flatfoot could be treated and if the severity could be the determinant of treatment.

Methods

We firstly collected footprints among juveniles aged 11–12. Secondly we chose the subjects with severe flexible flatfeet in whose footprints the ratio of solid area to hollow area in mid foot was 2:1, or there were no hollow area at all. Then we divided them into two groups according to their willingness to participate in experimental therapy. Finally, we recruited an experimental group with 20 severe flexible flatfeet and a control group with 20 severe flexible flatfeet. All the subjects claimed that they did not feel pain or tired in daily life.

After collecting the subjects, we separately measured the plantar pressure data of two groups. In this study, we mainly measured two data, one was contact area of mid foot, the other was load rate of mid foot. As the flexible flatfoot progresses, the arch will be deformed worse and will further lead to an abnormal increase in the contact area⁸ and load rate⁹ of the mid foot. Plantar contact area (in square centimeters) refers to the contact size between the plantar and the ground¹⁰. Plantar load rate is the plantar load-bearing ratio per millisecond, which was shown in N/ms¹¹. Since the main difference between flexible flatfoot and normal foot is whether the arch of mid foot is flat, the main plantar pressure difference between them is also in the mid foot¹². Therefore, this study mainly measured the contact area of mid foot and the load rate of mid foot.

Before measuring the data, the subjects were told to take off their shoes and wear the uniform socks. They needed to practice walking on the RSscan force plate at the speed of one step per second. When they were ready, the contact area of mid foot and load rate of mid foot were recorded by the RSscan system. All the data were measured three times to obtain the average value. Then the experimental group were treated by exercise therapy for 8 weeks. During treatment, they were told to do foot extension-flexion exercise, valgus and varus exercise, and short-foot exercise. For each exercise, they needed to do 16–20 movements in one group, 5 groups at a time, twice a day. After 8-week treatment, the contact area and load rate of mid foot were measured again. The repeated measure of SPSS 18.0 was used to analyze the data. The 95% confidence intervals (CIs) ($p < 0.05$) was considered statistically significant.

Results

It was shown that the contact area of mid foot decreased apparently from 46.275 to 39.917 in Experimental group. And there was no intersection of 95% confidence intervals between pre-after treatment, indicating that the contact area of mid foot after treatment was significantly declined in experimental group. (Table 1) This result was consistent with the references above^{8,10}. On the contrary, the contract area of mid foot in control group did not change much. The 95% confidence intervals intersected between pre-after measurement, showing that there was no significant difference between the first and second measurements. (Table 1)

Table 1
Contact area of 2 groups

Group	Factor	Mean	Std. Error	Sig. ^a	95% Confidence Interval	
					Lower Bound	Upper Bound
Experimental	Before	46.275	0.231	0.000	45.791	46.758
	After	39.917	0.254		39.384	40.450
Control	Before	45.961	0.289	0.234	45.356	46.565
	After	46.187	0.254		45.655	46.719

Additionally, the load rate of mid foot in experimental group reduced effectively from 1.663 to 1.053. And there was no intersection of 95% confidence intervals between pre-after treatment, showing that there was significant difference in load rate of mid foot compared with pre-treatment. The result was also consistent with the references above^{9,11}. However, the load rate of mid foot in control group was not changed much. The 95% confidence intervals intersected between first and second measurements, showing that there was no significant difference between them. (Table 2).

Table 2
load rate of 2 groups

Group	Factor	Mean	Std. Error	Sig. ^a	95% Confidence Interval	
					Lower Bound	Upper Bound
Experimental	Before	1.663	0.017	0.000	1.627	1.698
	After	1.053	0.022		1.007	1.100
Control	Before	1.674	0.014	0.076	1.644	1.704
	After	1.691	0.011		1.669	1.713

Besides, all the subjects did not feel any uncomfortable during the treatment.

Discussion

It was seen from the result that the contact area of mid foot and the load rate of mid foot were effectively lower than before. It was implied that the mid foot, in which the medial longitudinal arch was located, did not bear weight any longer just like the normal foot. In other words, because of the flat arch, the contact area of mid foot became larger¹³, which further lead to the increase in the load rate of mid foot¹². After treatment, the arches were not flat any more, which resulted in the reduction of the plantar pressure. The result in this study was consistent with the references above. Furthermore, flatfoot is famous for its flat

medial longitudinal arch. The main reason leading to the flat arch is that the muscular strength of tibialis anterior muscle, tibialis posterior muscle¹⁴, and the intrinsic muscles were too weak to hold the arch¹⁵. The result of this study indicated that after 8-week treatment, the plantar pressure data of juveniles with severe flexible flatfoot were significantly reduced. That means doing extension-flexion exercise, valgus and varus exercise, and short-foot exercise can helpfully increase the muscular strength. This result was consistent with the references above.

However, in the control group, the contact area of mid foot and load rate of mid foot were not significantly changed between pre-after measurements. As the improvement of living standards, the juveniles seldom walk, not to mention the exercise of lower limb muscles. Therefore, the flexible flatfoot came quietly among the juveniles, even if they did not feel pain or uncomfortable, it didn't mean they did not need the treatment at all. As we all have known that, flexible flatfoot could cause more diseases such like strephexopodia, disorder of foot bone, ankle disease and even knee and hip problems, the juveniles with severe flexible flatfoot should be treated as soon as diagnosed. Whether juveniles with flexible flatfoot needs the treatment should also depend on the severity but not merely on symptoms.

Conclusion

The contact area and load rate of mid foot were significantly declined after treatment. Exercise therapy could effectively improve the severe flexible flatfoot. If the juveniles with flexible flatfoot need the treatment should not depend on the symptoms only, but also on the severity. The juveniles with severe flexible flatfoot should be treated as soon as diagnosed.

Declarations

The study protocol was approved by the Institutional Review Board of The First Affiliated Hospital of Xi'an Jiaotong University. All the participants signed the written informed consent prior to the study participation.

The authors declare that they have no competing interests. YuSheng Qiu designed the study. JunNa Zhai carried out the experiment and drafted the manuscript. LiNa Shao performed the statistical analysis.

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