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A New Method for Foot Pathology Diagnostics

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Abstract : Early recognition of foot pathology is very important for proper foot development. Dynamic photoplantography is a cheap, informative and easy method for early foot pathology recognition. Photoplantograms of 683 children were studied. The glass pedograph equipped with a digital camera and a computer was used. Footprints were captured in sitting position, standing position, standing separately on the right and on the left foot. Ankle joint is in neutral position ; knee joint is directly over the midfoot. Foot indices were studied in dynamic under increasing foot pressure. Flat foot frequency among 3 year old children was 53%. By 7 years flat foot frequency was 15%. Frequency among 14 year old children was 5%. Longitudinal arch index in 2 year old group was 0.83 and it was increased by 5% in standing position, longitudinal arch index in 6 year old group was 0.6 and it was increased by 20% in standing position, longitudinal arch index in 14 year old group was 0.54 and it was increased by 13% in standing position. Dynamic photoplantograms allowed us to divide foot deformity into rigid and flexible types. Dynamic photoplantography examination is a good method for foot pathology diagnostics.

Introduction

Early recognition of foot pathology is very important for proper foot development. Dynamic photoplantography examination is a good method for foot pathology diagnostics. Dynamic aspect of the study brings us new features in diagnostics. Changing of foot indices upon weightbearing was analyzed. Flexibility of foot structures was easily estimated with information about indices changing. Footprints are collected in a few minutes and could be analyzed and stored. We've got objective information that helps us to take treatment decision. Treatment result is also performed with this method easily. Dynamic photoplantography is a cheap, informative and easy method for early foot pathology recognition. It can be used as a screening method for large collective tests.

Methods

Our research was performed at schools and at the child orthopedic department. Photoplantograms of 683 children were studied. The glass pedograph equipped with a digital camera under it and a computer was used. Three photoplantograms of each foot were captured and analyzed. Footprints were captured in sitting

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Fig. 1. Dynamic photoplantography examination a|b|c|d
a : Sitting position. b : Standing position. c : Standing separately on the right foot.
d : Standing separately on the left foot.

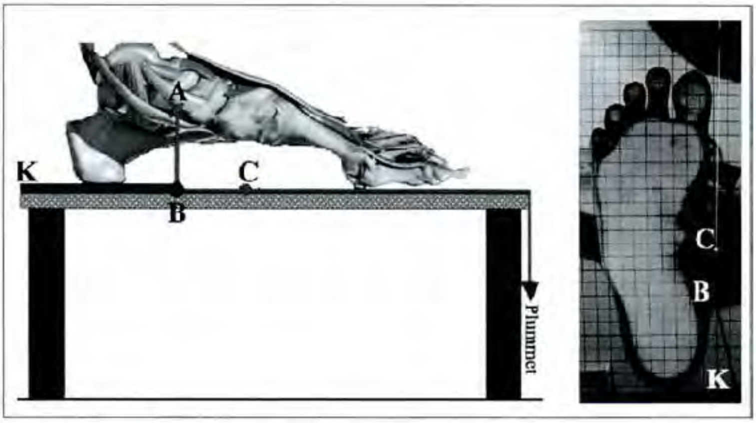

Fig. 2.
Method of longitudinal arch height measurement.
A segment(AC)was marked on the thread. Length of the AC segment is known and constant(AB segment is 10 cm). Free end of the thread(point A) is fixed above tibialis posterior tendon attachment. The thread passes through guiding pulley (KB) at right angle. Length of the BC segment was measured by means of photoplantogram. Arch height is : AB AC BC. Dynamic of the arch flattening under weightbearing was studied.

a|b

Fig. 3.
a : Transmalleolar angle angle between foot sole axis and transmalleolar line. b : Transmalleolar axis angle between perpendicular on transmalleolar line and thigh axis. This is a measure of tibial rotation.

position(foot pressure is minimum), standing position, standing separately on the right and on the left foot(foot pressure is maximum similarly to the midstance of gate cycle). Ankle joint is in neutral position ; knee joint is directly over the midfoot(Fig. 1). Foot indices were studied in dynamic under increasing foot pressure(in sitting and standing position). The next foot indices were studied : foot length and width, length/width ratio, transverse arch function(foot width in sitting/standing position ratio), longitudinal arch flattens under weightbearing (longitudinal arch index in dynamic), foot length/body height ratio, arch index[4]. This method made it possible to estimate subtalar complex torsion and tibial torsion. For this purpose we used mirrors and luminodiods(it was settled directly under tips of malleoli). Ankle joint axis passes through tips of malleoli[1]. Height of longitudinal arch at the level of tibialis posterior tendon insertion was measured(Fig. 2). Transmalleolar angle and transmalleolar axis were measured by means of photoplantograms(Fig. 3). Transmalleolar angle corresponds to subtalar complex rotation (normal value is 85-90 degree) (Fig. 3-a)[2]. Transmalleolar axis corresponds to tibial tor-

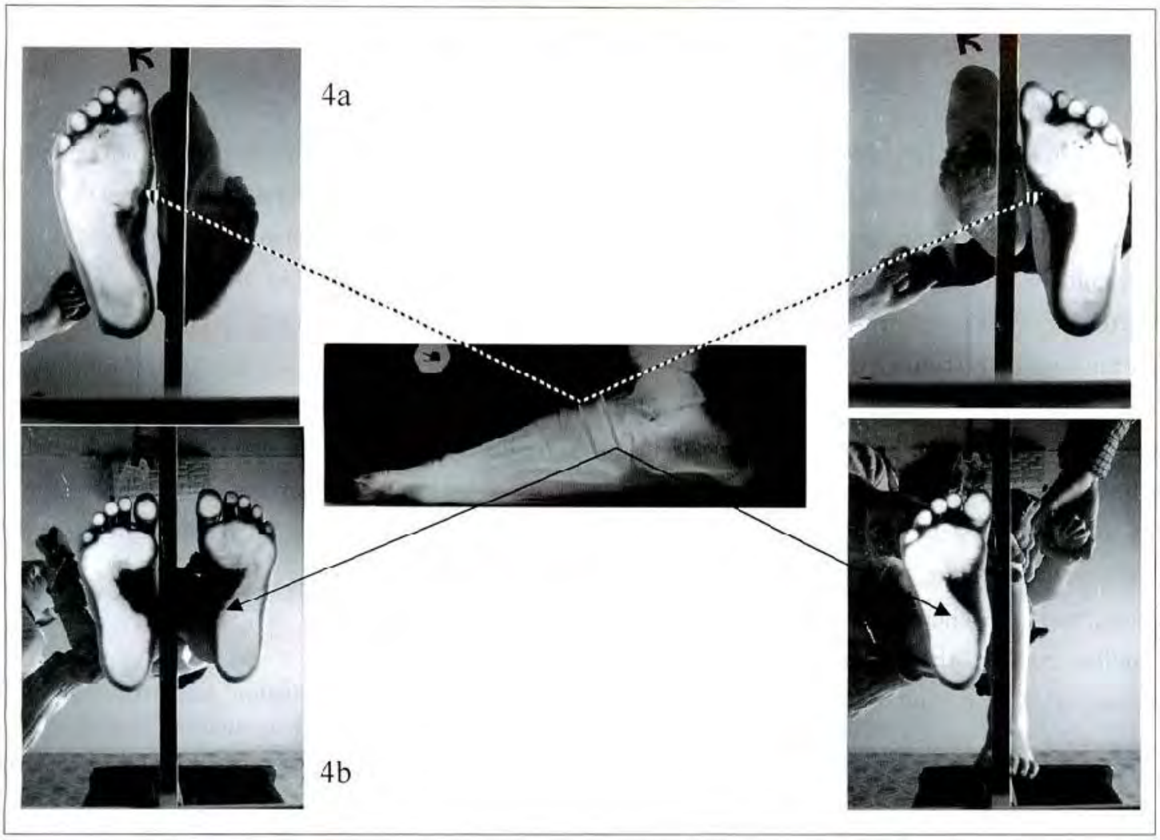

Fig. 4. Longitudinal arch flattening
a : Longitudinal arch flattening predominantly in distal part means that flattening happens due to naviculocuneiform joint sag. b : Longitudinal arch flattening predominantly in proximal part means that flattening happens due to talonavicular joint sag.

sion(Fig. 3-b)[3]. Photoplantographic measurement was made with the help of computer. Measurement inaccuracy amounts to 1 cm± 0.003(p=0.05).

Results

Until age seven foot development is very active. There is fat pad under longitudinal arch until the age of 3 years. It makes foot appear flat and treatment can be prescribed mistakenly. The most frequent deformity was flat foot. Flat foot frequency among 3 year-old children was 53%. By 7 years flat foot frequency was 15%. Frequency among 14 year-old children was 5%. Frequency of flat foot deformity among 3 year old children was very high. Frequency of flat foot reduced sharply by 14 years. We use term developmental flatfoot among children under 5 years. Longitudinal arch index in 2 year old group was 0.83 and it was increased by 5% in standing position(arch reaction wasn't marked due to presence of fat pad under arch), longitudinal arch index in 6 year-old group was 0.6 and it was increased by 20% in standing position, longitudinal arch index in 14 year-old group was 0.54 and it was increased by 13% in standing position(foot structures became stable). Dynamic photoplantograms allowed us to divide foot deformity into rigid(no arch in sitting position) and flexible types(foot arch flattens only under patient's weight, with normal arch width in sitting position). There are proximal and distal parts in longitudinal arch. Longitudinal arch flattening may be in distal or proximal part. Longitudinal arch flattening predominantly in distal part means that flattening happens due to naviculocuneiform joint sag. Longitudinal arch flattening predominantly in proximal part meansthat flattening happens due to talonavicular joint sag(Fig. 4). Foot width under weightbearing increased. Ratio of foot width in sitting position to foot width in standing position gave us information about transverse arch flattening. Normally this index was more than 7%. When transverse arch index was smaller than 7% then transverse arch sag was suspected. Cavus foot deformity was divided into rigid and flexible forms. In the case of flexible cavus deformity operation was performed on soft tissue component.

Discussion

This method has given us new features in foot pathology diagnostic. This investigation is easy to perform. Flatfoot deformity was the most frequent deformity detected among children. In most cases it was due to ligament laxity, then longitudinal arch sag uniform, also proximal or distal arch part sag could be diagnosed. This information was useful for localizing the point of arch sag. Dynamic photoplantography is a cheap, informative, easy method in early foot pathology recognition. It can be used as a screening method among large collectives. Functional photoplantograms helps us to estimate foot arches function. Dynamic photoplantography makes treatment easy to be performed.

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