

RESEARCH ON THE GAIT OF HEALTHY CHILDREN FROM 2 TO 6 YEARS OLDS

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Abstract: In order to show the basic characteristics of gait development of healthy children, this paper involved 320 children aging from 2 to 6 years old to test the gait during walking. The result showed that after two years old, knee joint participated in flexion and extension. 49 to 72-month-old children's knee joint angle can be fully extended when it is stretching. And that is close to the normal adults. From 3 years old and later, ankle joints also started to participate. With the increase of month, impulse from 1 to 5 metatarsal tended to be stable. And the impulse of inner side of foot was all larger than that of the lateral side.

KEYWORDS: CHILDREN , GAIT , PLANTARPRESSURE

INTRODUCTION: With the development of physical conditions, healthy children whose size of foot and gait is very different from adults', which will show different characteristics of gait at different stages. The study of gait abroad dated from 18th century, is of perfect with each passing day with maturity ^[1, 2]. But there is few or no such study in China, and is especially in the lack of describing about gait changes of children. Previous studies were conducted by generally describing the law of gross motor movement development, or analyzing the plantar pressure characteristics of elder children ^[3-5]. Therefore, previous researches are short of systematical analyses of kinematics and kinetics parameters of gait and foot parameters changes. Foreign researches show that the space-time parameters and kinematics parameters of four years old children are generally come up to the mature level ^[6-9]. The purpose of this study is to show gait and foot parameters changes at different stages of healthy children in China, and to conduct the investigation of the parameters differences between healthy children and adults, and to measure when the children come up to the mature standards. Moreover, the author attempts to find out factors that affect gait mature, and provide the beneficial reference for educators to train children scientifically in order to improve children' health.

METHOD: The groups were divided to 8 groups by age and gender. There are 20 children in each group. All the dates were collected by Footscan plate system product by Rsscan International, Easy foot scanner and constant speed cameras at the same time. Two Sony video cameras were used to capture the front and side view of walking, whose frequency is 50Hz. The standard error of this experiment is less than 0.5mm. Then the author analyzed videos taken in this experiment with DV Racker motion pictures analyzing system. When the author combined and analyzed the data, the Statistical Package for Social Sciences (SPSS 13.0) was used.

RESULT AND DISCUSSION:

Table 1 Dates of the Knee And Ankle Angle (°)

Group	The touchdown movement of knee	The end of flexion for knee	The end of knee extend	The touchdown movement of ankle	The end of for ankle	The end of ankle extend
1	175.87 ±3.62#	162.56 ±13.08**	171.91 ±15.47	105.85 ±15.26	104.46±11.42	107.08±18.72 **
2	171.89 ±3.68	157.30 ±11.75	170.44 ±13.33	100.74 ±16.43ΔΔ	96.12± 16.53*ΔΔ	103.05±17.89
3	174.58 ±7.24	160.82 ±13.33	167.57 ±13.26	105.11 ±9.26	95.60± 10.17	100.98±17.56
4	176.60 ±6.77	161.17 ±11.00	168.25 ±12.06	101.66 ±14.86	91.63± 8.97	96.13 ±14.43
5	173.07 ±7.81	155.52 ±14.05ΔΔ	163.79 ± 11.03	94.87 ± 15.30*	90.21± 9.47	98.67 ±13.43
6	176.12 ±3.95	154.20 ± 12.57ΛΛ	162.05 ±12.96	94.58 ±10.02	91.82± 14.79	101.41±16.39
7	174.74 ±3.95	151.55 ± 10.27	161.42 ±17.91	95.29 ±14.80	87.01±12.62	108.63±14.99
8	172.89 ±4.49	150.70 ±8.65	160.64 ±11.11	97.86± 15.31	89.90±12.85	115.01±14.23

Note: * represents a half year old infant group comparison, # represents one year old infant group comparison, Δ represents two years old infant group comparison, Λ represents three years old infant group comparison, * # ΔΛ means that p is less than 0.05 and ** ## Δ Δ ΛΛ means that p is less than 0.02, and the same below.

From Table1, after two and a half years, at the end of flexion for knee joint, the angle value has significant differences. Because their weight capacity for knee joint increases, and the angle of knee joints increases at first, and then decreases. The body's center line is perpendicular to the ground when their knee joints provide support for them to stand up, and the weight capacity for knee joints reach maximum. The angle of knee joints is not large, which is about 162°.

There is no obvious dorsiflexion for the ankle joint of children, especially when they begin to learn to walk; they are mainly by entire feet touch the ground, and their extend capacity is not so good. After two years old, their steps are steady, they come down heels first, and then their entire feet gradually touch the ground. In the duration of stance, the ankle joints

begin to dorsiflex when they land on their heels, and when their toes are off the ground, planter flexion is used to lengthen their legs.

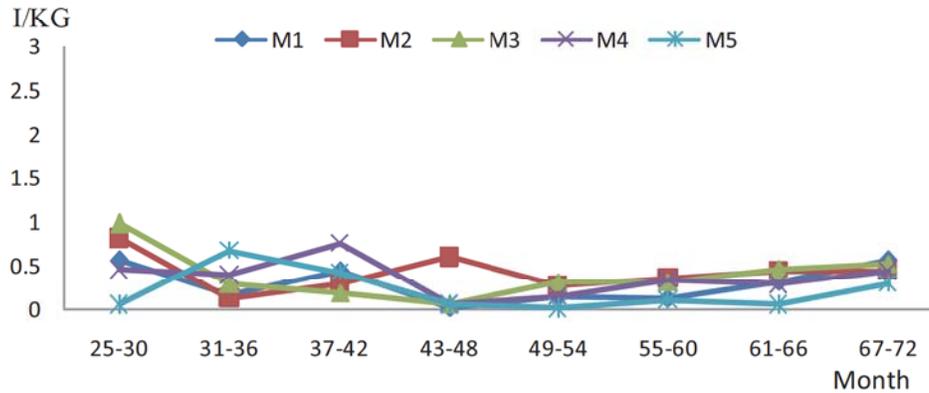


Fig.1 The change of metatarsal's impulse per unit weight

From Fig.1 we can see that with the increase of month, I/KG tends to be stable, and I/KG of lateral become little. After 4 years old, I/KG of inner side of foot are all larger than the lateral foot's. And the pressure center track moves to the medial foot, which is more like adult. From fig.1 we can see that after 6 years old, the value of I/KG has a relationship that is $M1 > M2 > M3 > M4 > M5$, which is the result that the first and second metatarsal have participated in the stretch stage totally.

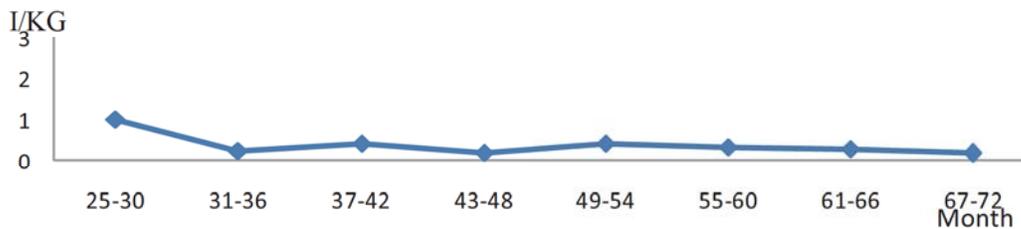


Fig.2 The change of mid-foot impulse per unit weight

From fig.2, we can see that with the growing of age, the arch of foot become distinctly, aged from 31-36 month, where the impulse decreased. At the same time the percentage of mid contact area is less than 28%.

CONCLUSION: First, after four years old, knee joint angle can be fully extended when it is stretching. And that is close to the normal adults. From 3 years old and later, ankle joints also start to participate. Second, with the increase of month, impulse from 1 to 5 metatarsal tends to be stable. And the impulse of inner side of foot was larger than that of the lateral side. Third, with the growing of age, the arch of foot became distinctly, and where the impulse decreased. The percentage of mid

contact area is less than 28%. And the force during toe off looked like the adult when they are near 6 years old.

ACKNOWLEDGEMENTS: This work was financially supported by the Liaoning Charitable Foundation (2014001011) and Research Project in the university and college of Liaoning Education Commission (L2014466).

REFERENCES:

- [1]Kai Li. Research Advancement of Children's Gait. China Sport Science, 2009, Vol.29:72-75.
- [2]WANG Xin, GUAN Xin. The Gait Kinematics Analysis for Healthy Infant Aged from One to Six[J].Journal of Beijing Sport University,2012,07:66-69.
- [3]YANGLu-ming,YAN Shi-yang,HAO Fu-rong, RAN Mei-ling, WU Shu-wen. Developments in Obese Children's Gait Characteristics and Plantar Pressure Distribution[J]. Leather Science and Engineering,2013,05:30-34.
- [4]WUTing,GONGTaisheng,ZHOUYue,ZHANGCui.Research on plantar pressure and gait for children aged from 6 to 10 in loading condition[J].China Leather ,2015,13:24-26.
- [5]FANG Zheng, ZHANG Xingliang, WANG Chao, GU Xin, MA Shenglin, WANG Lei, CHEN Siyuan. Experimental Gait Study Based on the Plantar pressure Test for the Young People[J].Journal of Biomedical Engineering,2014,06:1278-1282.
- [6] TASUKU KIMURA,NAOKO YAGURAMAKI, MASAKIFUJITA, et al. Development of energy and time parameters in the walking of healthy human infants[J].Gait Posture,2005,22:225-232.
- [7] KATHLEEN J GANLEY, CHIUSTOPHER M POWERS. Gait kinematics and kinetics of 7-year-old children:a comparison to adults using age-specific anthropometric data[J].Gait Posture,2005,21:141-14
- [8] NAOKO YAGURAMAKI , TASUKU KIMURA . Acquirement of stability and mobility in infant gait [J].Gait Posture, 2002,16:69-77.
- [9]GravanteG, RussoG, PomaraF,et al. comparison of reaction forces between obese and control young adults during quiet standing on a baropodmetric platform [J].Clin Biomech,2013,18(8):780-782