

Does Soccer Practice Stress the Degrees of Genu Varo?



Leandro Fórnias Machado de
Rezende¹
Maurício do Santos¹
Timóteo Leandro Araújo¹
Victor Keihan Rodrigues Matsudo¹

1. CELAFISCS – Study Center of the
Laboratory of Physical Aptitude of
São Caetano do Sul, SP, Brazil.

Mailing address:

Rua Taipas, 77, ap. 22, Barcelona –
09560-200 – São Caetano do Sul, SP,
Brazil
E-mail: leandro@celafiscs.org.br

ABSTRACT

Studies have shown progressive genu varum increase between the childhood and adolescence periods. Variables such as age, weight, vitamin/hormone intake, the environment and soccer training may interfere in the knee alignment. Objective: a) to compare the knee alignment in soccer and non-soccer practitioners, and b) to determine associations between this alignment and anthropometric and neuromotor variables. Methods: The intercondylar (ICD) and intermalleolar (IMD) distances were measured in centimeters in 128 male aged from 14-17 years, soccer practitioners (n=65) and non-practitioners (n=63). The anthropometric variables measured were: body weight and height, whereas the neuromotor variables included agility and speed. Results: Soccer players revealed a greater degree of genu varum (IC) than non-soccer players in all ages, but just in 14, 17 years-old and total group (all ages together) these differences were statistically significant ($p < .05$). Genu valgum (IM) tended to be less remarkable in soccer players than in non-soccer players in all ages; however, significant differences were observed only in 17 years and total group ($p < .05$). The IC distances in soccer players correlated ($p < .05$) with agility ($r = -.27$), weight ($r = -.27$); while IM distances correlated ($p < .05$) with weight ($r = .26$). Conclusion: Soccer players showed more remarkable genu varum than the non-soccer players. There was a significant association between degrees of varus and valgum with body weight and agility. Such fact deserves further investigation in order to explain this interesting correlation. Present findings support the hypothesis that soccer leads to greater genu varum and/or this sport naturally selects subjects with a certain degree of genu varum.

Keywords: knee alignment, sports, adolescents, performance.

INTRODUCTION

The frontal plane knee alignment has been the issue of research, especially due to its clinical importance. The incongruence of the lower limbs, especially the knee's, may be related to articular instability and pain⁽¹⁾. Disorders in these structures may also cause problems in muscular support, tendons, ligaments and retinacula, alternating the knee alignment between genu varum or genu valgum, changing hence knee function⁽²⁾.

The impact of the knee alignment has become important in the sports environment both due to its relation with the muscle pain and injuries and to its association with the physical fitness variables^(3,4,5).

The frontal plane knee alignment normally ranges according to age in male children⁽⁶⁾. Prevalence of 65.2% of genu valgum was found from the first to the seventh year of life, 30.4% of neutral knee from eight to 12 years and 51.1% of genu varum from 13 to 18 years old.

It is worth remembering that factors such as race, weight, vitamin contribution, metabolic/hormone disorders, environment and soccer practice can also influence on the knee alignment^(7,8).

The study had the aims to: a) compare the frontal plane knee alignment according to chronological age in soccer

players and students; b) analyze the associations between frontal plane knee alignment and the anthropometric and neuromotor variables of physical fitness.

MATERIALS AND METHODS

The study was based on a non-casual sample by convenience, involving 128 male subjects aged between 14 and 17 years (15.14 ± 1.1) from Ilhabela, Guarulhos and São Paulo regions. This age group was chosen since regular soccer practice should begin between 12-14 years so that early specialization of the individuals does not occur^(9,10). These subjects were separated in two groups: soccer practitioners and non-practitioners (students).

The first group was composed of 65 soccer players from two clubs of São Paulo state (A.D. Guarulhos and São Paulo F.C.). In order to be a member of this group, the subjects needed to engaged in a structured soccer training program of a minimum of three weekly sessions of 60 minutes each. This information was collected through a questionnaire with information on age, birth date, time of practice and injury history.

The second group included as control was composed of 63 students from the Ilhabela region, São Paulo, who did not participate in soccer training programs.

Both groups were divided in four subgroups:

- Group I** – 14 years (n = 6 soccer players and n = 27 students);
- Group II** – 15 years (n = 22 soccer players and n = 18 students);
- Group III** – 16 years (n = 16 soccer players and n = 10 students);
- Group IV** – 17 years (n = 21 soccer players and n = 8 students).

The sampling calculation was not done since the data of the control group were extracted from a longitudinal project in the 2009/2010 years, which limits the inference that soccer practice may interfere on the knee alignment. A Free and Clarified Consent Form was handed in and signed by the legal responsible individuals of the respective underage participants.

In this study, the anthropometric variables weight and height were assessed and subsequently used for determination of some association with the knee alignment. Biological maturation was analyzed through self-evaluation (correlation of 0.6-0.7 with pubic hair and 0.6 with breasts and genitals) of biological maturation⁽¹¹⁾, and no difference was found between groups.

The intercondylar (ICD) and intermalleolar (IMD) distances were measured with the subjects at orthostatism, barefoot, wearing shorts and on flat floor, with hips, knees and ankles at neutral position⁽¹²⁾. Therefore, the subjects were asked to adduct the lower limbs until the medial femoral condyle or the medial tibial malleolus bones touched. When the medial tibial malleolus bones came closer and touched first, the medial femoral intercondylar distance was measured in centimeters. These subjects were then classified as genu varum. When the reverse situation occurred, medial femoral condyles touched, the medial tibial intermalleolar distance was measured in centimeters. In that case, the subjects were classified as genu valgum. When there was simultaneous intercondylar and intermalleolar contact, the subjects were classified as neutral; that is to say, IC and IM equal to zero. The instrument used for this measurement was a goniometer.

The *shuttle run*, vertical impulse with and without help of upper limbs and 50-meter velocity tests were applied to measure agility, strength of lower limbs and velocity, respectively. All neuromotor tests followed standardization by the CELAFISCS⁽¹³⁾.

Statistics analysis used the Kolmogorov-Smirnov normality test, which indicated the non-parametry of the data. The chi-square test was used to compare the knee alignment ratios of the groups. The Kruskal Wallis and Mann Whitney tests were used for comparison of intercondylar (ICD) and malleolar (IMD) means within the same groups and in different groups, respectively. The Spearman Rho test was used to measure the correlation between the knee alignment and the anthropometric and neuromotor variables.

The Free and Clarified Consent Form was signed by the legal responsible individuals of the underage participants. The Longitudinal Project of Increase and Development of Ilhabela, from which part of this sample was taken is approved by the Ethics Committee of the Federal University of São Paulo (Unifesp).

The statistics package used was the SPSS 15.0 for Windows. The significance level adopted was $p < 0.05$.

RESULTS

Table 1 describes the characteristics of the soccer players and students.

The prevalence of the frontal plane knee alignment in genu varum, genu valgum or neutral is described in table 2. When the frontal plane knee alignment is assessed, prevalence of 67.7% of genu varum can be observed in the soccer practitioners' group and of 30% in the students ($p < 0.05$). Genu valgum in soccer practitioners obtained prevalence of 21.5%, while in the students this value was of 52.3% ($p < 0.05$). Neutral knees in the soccer practitioners presented prevalence of 10.7% and of 14.2% in the students ($p < 0.05$).

In the students' group, the ICD presented increase tendency from 14 to 16 years, and light decrease at 17 years, data which are not statistically significant. In the IMD, there was oscillation between the age groups compared.

There was an increase tendency of the ICD levels among the soccer practitioners according to age progression from 15 to 17 years, while the IMD levels oscillated between ages; however, these values were not statistically significant.

In all ages the ICD was higher in the soccer practitioners' group when compared to the students' group. However, only at 14 and 17 years this difference was statistically significant ($p < 0.05$) (Figure 1).

The opposite episode has occurred with IMD, where all ages this measurement was lower in the group of soccer players compared to the students' group. Nevertheless, this difference was only significant at 17 years old ($p < 0.05$) (Figure 2).

When a general comparison was established between groups, the ICD was 95.85% higher in the group of soccer players than in the students' group ($p < 0.05$), while the IMD presented opposite phenomenon, with the soccer players with a difference of -32.47% when compared to the students ($p < 0.05$) (Figure 3).

The ICD and IMD of the group of students presented statistically significant negative correlation ($r = -0.46$). However,

Table 1. Characterization of the sample of soccer practitioners and students.

	Age		Weight		Height	
	X	S	X	S	X	S
Soccer players	15.8	1.0	64.6	9.7	173.1	7.0
Students	14.9	1.0	56.6	13.6	166.2	9.9

* $p < 0.05$.

Table 2. Prevalence of knee alignment in soccer players and students.

	Genu varum		Genu valgum		Neutral	
	n	%	n	%	n	%
Soccer practitioners	44	67.7*	14	21.5*	7	10.8*
Students	19	30.1	33	52.4	11	17.5

* $p < 0.05$ – Difference between groups.

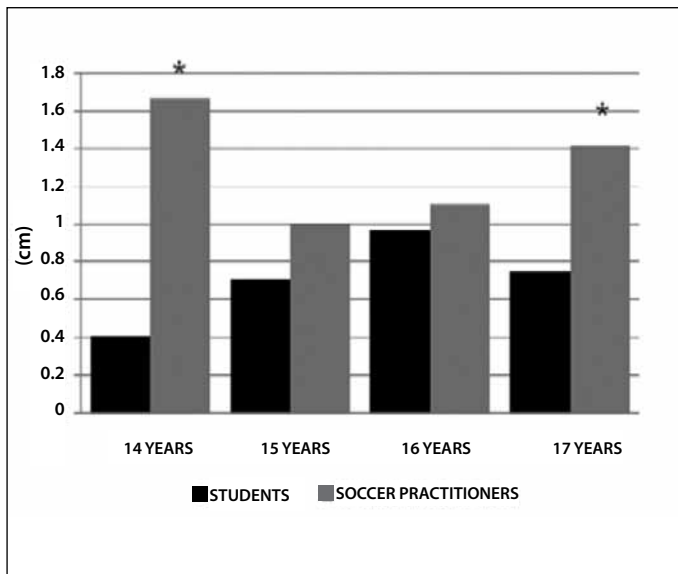


Figure 1. ICD between practitioners and students.

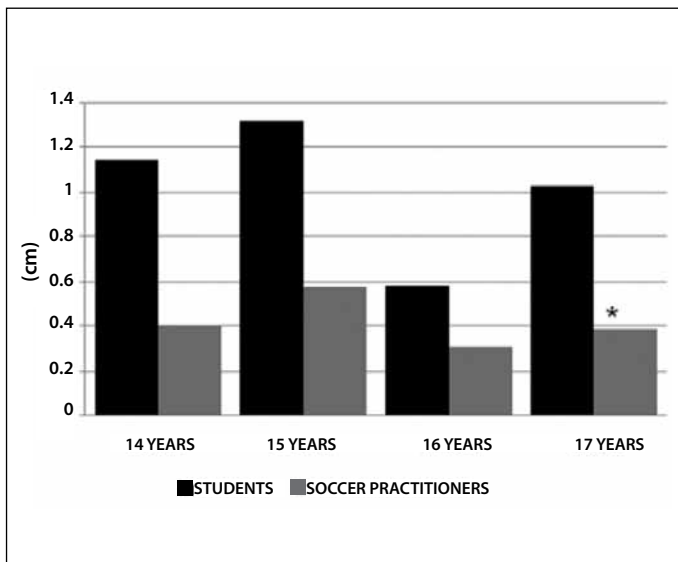


Figure 2. IMD in students and soccer practitioners.

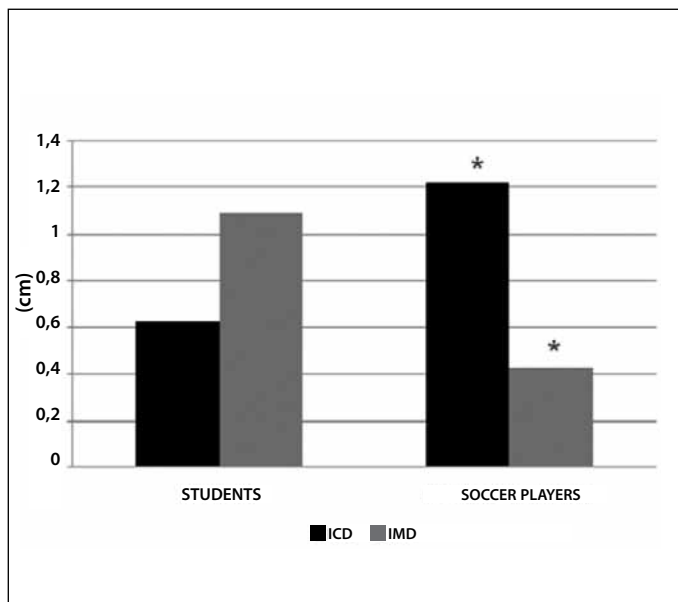


Figure 3. ICD and IMD in total group of soccer players and students.

none distances presented significant correlations with the researched physical fitness variables. On the other hand, the ICD of the soccer practitioners presented significant correlation ($p < 0.05$) with agility ($r = -0.27$) and weight ($r = -0.27$), while the IMD with weight only ($r = 0.26$) (Table 3).

DISCUSSION

Prevalence of 70% of genu varum in former soccer athletes has been shown in previous studies⁽¹⁴⁾. However, for this study, the cause-effect phenomenon, that is, the soccer environment causing severity in knee bandiness, cannot be established since 47% of the researched knees suffered meniscal surgery and had radiological osteoarthritis, facts which can be associated with this bad alignment.

These postural swerves are in important realities to be analyzed by the health professionals involved with soccer, since they can cause overload on the osteomyoarticular structures and be able to make the limbs of athletes of different modalities vulnerable to injuries^(15,16).

The soccer practitioners of this study presented prevalence of 67.7% of genu varum; 21.5% genu valgum and 10.8% of neutral knees. The students' group presented prevalence of 30.1% of genu varum; 52.4% of genu valgum and 17.5% of neutral knees. Thus, it can be observed that to a certain extent in this sample, progres-

Table 3. Correlations between the anthropometric and neuromotor variables with the frontal plane knee alignment in students and soccer practitioners.

	Soccer practitioners				Students			
	x	S	ICD r	IMD r	x	S	ICD r	IMD r
Age (years)	15.8	1.0	0.7	-0.13	14.9	1.0	0.03	0.12
Weight (kg)	64.6	9.7	-0.27*	0.26*	56.6	13.6	-0.01	0.23
Height (cm)	173.1	7.0	-0.12	-0.02	166.2	9.9	0.06	0.21
IVS (cm)	39.4	4.7	0.04	0.09	34.4	7.5	0.16	0.05
IVC (cm)	47.5	6.1	0.05	-0.20	43.3	8.2	0.19	-0.17
Agility (sec)	9.5	0.3	-0.27*	0.20	11.2	0.9	-0.15	-0.13
Velocity (sec)	7.3	0.5	-0.14	0.20	8.3	0.9	-0.21	0.09

* $p < 0.05$.

sive genu varum increase with age in both groups. However, the group of soccer practitioners presented more remarkable genu varum levels than the control group, being these differences statistically significant ($p < 0.05$).

These data corroborate the study which compared the percentage distribution of the frontal plane knee alignment from 12 to 17 years in one male group of soccer practitioners and another group of boys who did not practice it and a third group of female adolescents⁽¹⁷⁾. There was higher prevalence of genu varum in the male soccer athletes (73.5%), which was higher than in the boys who did not practice soccer (40.58%), followed by the female group (14.12%).

Concerning the distribution of the genu valgum alignment, the female group presented higher prevalence (62.35%), followed by the group of boys who did not practice soccer (31.89%) and for last the group of soccer athletes (12.02%). Concerning the prevalence of the neutral position knee alignment, there was oscillation among groups, where the group of athletes presented 14.73% of the cases; the group which does not practice soccer, in 27.53%, and the female group with 23.53%.

In a trial to demonstrate that external phenomena such as engagement in a structured soccer program could influence on the frontal plane knee alignment, this study performed comparison between individuals who practice soccer and those who do not practice it. Difference in the alignment of this articulation was found in all age groups between groups, including in the total group. However, this difference was statistically significant ($p < 0.05$) only for the groups from 14 to 17 and the total group.

In a study comparing the intercondylar and intermalleolar distances of 336 soccer practitioners and 428 non-practitioners aged 8 to 18 years⁽⁸⁾, difference in the frontal plane knee alignment between the group of soccer practitioners and non-practitioners can be found; however, this difference was statistically significant only in the group from 16 to 18 years, demonstrating more remarkable genu varum level in the group of soccer practitioners. According to the same author, the hypothesis for such phenomenon may be attributed by the load offered to the knee medial compartment during the soccer specific actions such as kicking and passing.

Frontal plane knee alignment evaluation in individuals aged between 10 and 21 years, out of which 106 belonged to a group of soccer players and 68 were tennis practitioners was performed in a previous study⁽¹⁸⁾. The regression performed in this group demonstrated a statistically significant difference ($p < 0.001$) between groups from 13 years of age, where the soccer practitioners presented more remarkable genu varum than the tennis practitioners. When this same analysis was performed in groups (10 to 13 years, 14 to 16 years and 17 to 21 years), statistically significant difference was found in favor to the soccer practitioners only in the intermediate group ($p < 0.0006$) and in the more advanced age group ($p < 0.001$). The

authors support the idea that there is a natural selection in this modality of the individuals who present more remarkable knee alignment in genu varum.

The associations between frontal plane knee alignment and the anthropometric and neuromotor variables were found in the present study only in the group of soccer practitioners, where the ICD obtained statistically significant association ($p < 0.05$) with weight (-0.275) and agility (-0.276), while the IMD significantly associated with ($p < 0.05$) only with body weight (0.260).

However, a positive and significant association ($p < 0.05$) between genu valgum and agility ($r = 0.21$) and velocity ($r = 0.22$) has been presented in a previous study⁽⁶⁾. The authors suggest that the knee genu valgum may imply in biomechanical difficulties during movement and gestures which involve the lower limbs, decreasing performance in activities or sports which need these variables.

Positive and significant associations have also been found ($p < 0.05$) between the levels of genu varum and the anthropometric variables age ($r = 0.34$), height ($r = 0.29$), weight ($r = 0.42$) and BMI ($r = 0.35$), as well as with the neuromotor variables vertical thrust ($r = 0.44$) and negative and significant association ($p < 0.05$) with velocity ($r = -0.28$) in the male gender⁽⁵⁾. The same authors concluded that some levels of genu varum could favor sports performance which requires the variables velocity and vertical thrust.

Among some of this study's limitations, the transversal approach with a convenience sample extracted from a longitudinal study, not performing hence the sample calculation, prevents one from deeply inferring especially on the cause/effect relation between knee alignment and soccer practice, besides the correlations with physical fitness of the young men. Therefore, further longitudinal studies in this research flow which present the effect sports practice, namely soccer here, can have on the frontal plane knee alignment are suggested.

CONCLUSION

When the frontal plane knee alignment of soccer practitioners and students who did not practice soccer was compared, difference in the knee alignment at 14 and 17 years and more remarkable levels of genu varum was observed in the group of soccer players.

The remarkable levels of genu varum presented association with improvement in agility, performance, an interesting and promising fact which should receive future attention. However, further studies with other age groups and with control of engagement time in the soccer structured program are suggested in order to corroborate the alteration of frontal plane knee alignment with soccer practice, as well as of the association of these with the physical fitness variables.

All authors have declared there is not any potential conflict of interests concerning this article.

REFERENCES

1. Severino NR, Camargo OPA, Aihara T, Cury RP, Oliveira VM, Vercesi AE, Ferreira Filho M, Barbi L, Medeiros SF. Realinhamento do aparelho extensor na luxação patelofemoral recidivante. *Rev Bras Ortop* 1998;33:249-51.
2. Ahlberg A, Moussa M, Al-Nahdi M. On geographical variations in the normal range of joint motion. *Clin Orthop Relat Res* 1988;234:229-31.
3. Fu FH, Stone DA. *Sports Injuries mechanisms, prevention, and treatment*. 2nd ed. Philadelphia: Lippincott Williams &Wilkins, 2001.
4. Garcia N, Matsudo SM, Matsudo VKR. Relação entre Aptidão Física, Genu Valgo em Crianças e Adolescentes. *Anais XXIII Simpósio Internacional de Ciências do Esporte 2000*; p.142, São Paulo, Brasil.
5. Cassimiro, A, Andrade DR, Oliveira LC, Matsudo VKR. Relação entre o Genuvaro e a Aptidão Física em Crianças e Adolescentes. *Rev Brasileira Ci e Mov* 2009;17:01-22.
6. Gomes, CT, Kaiserman LS, Kroeff MAH, Crestani MV. Variação das distancias intermaleolar e intercondiliana nos jovens. *Rev Bras Ortop* 1997;32:963-6.
7. Volpon JB, Abreu EM, Furchi G, Nisiyama, CY. Estudo populacional do alinhamento do joelho no plano frontal durante o desenvolvimento. *Rev Bras Ortop* 1986;21:91-6.
8. Witvrouw E, Danneels L, Thijs Y, Cambier D, Bellemans J. Does soccer participation lead to genu varum? *Knee Surg Sports Traumatol Arthrosc* 2009;17:422-7.
9. Greco PJ, Benda RN. Iniciação esportiva universal 1: da aprendizagem motora ao treinamento técnico. Belo Horizonte, Escola de Educação Física da UFMG, 1998.
10. Tani G, Teixeira RL, Ferraz OL. Competição no esporte e na educação física escolar. In: Conceição JAN (coord) *Saúde escolar: a criança, a vida e a escola*. Sarvier 1994;33:73-86.
11. Matsudo SMM, Matsudo VKR. Validade da Auto-avaliação na determinação da maturação sexual. *Rev Bras Ci e Mov* 1991;5:18-35.
12. Cheng JC, Chan PS, Chiang SC, Hui, PW. Angular and rotational profile of the lower limb in 2,630 Chinese children. *J Pediatr Orthop* 1991;11:154-61.
13. Matsudo VKR. *Testes em ciências do esporte*. 7ª ed. São Caetano do Sul: Centro de Estudos do Laboratório de Aptidão Física de São Caetano do Sul, 2005.
14. Chantraine A. Knee joint in soccer players: osteoarthritis and axis deviation. *Med Sci Sports Exerc* 1985;17:434-9.
15. Ribeiro CZP, Akashi PMH, Sacco ICN, Pedrinelli A. Relação ente alterações posturais e lesões no aparelho locomotor em atletas de futebol de salão. *Rev Bras Med Esporte* 2003;9:91-7.
16. Leite CBS, Neto FFC. Incidência de lesões traumato-ortopédicas no futebol de campo feminino e sua relação com as alterações posturais. *EF Deportes Revista Digital* 2003;9.
17. Abreu AV, Barbosa JRP, Coelho FJP. Alinhamento dos Joelhos no plano frontal dos 12 aos 17 anos. *Rev Bras Ortop* 1996;31:83-8.
18. Yaniv M, Becker T, Goldwirt M, Khamis S, Steinberg DM, Weintraub S. Prevalence of Bowlegs Among Child and Adolescent Soccer Players. *Clin J Sports Med* 2006;16:392-6.
19. Gonçalves, DV, Santos, ARB, Duarte CR, Matsudo, VKR. Avaliação postural em praticantes de natação: uma análise crítica. *Rev Bras Ci Mov* 1989;3:16-23.
20. Motta JA. A postura como fator de observação na escola. *Rev Bras Ci e Mov* 1991;5:36-9.