

Impact on Anatomy Learning: Analysis of Clinical Anatomy League of University of São Paulo Medical School (FMUSP) Methodology

Leandro Ryuchi Iuamoto^{1*}, Thiago Machado Nogueira^{1*}, Braian Lucas Aguiar Sousa^{1*}, Alfredo Luiz Jacomo^{1*}

¹Human Structural Topography Discipline, Department of Surgery, University of São Paulo Medical School, Dr. Arnaldo Avenue, 455 Level 1, Sao Paulo, Brazil. Phone: (55 11) 3061.8277

* Correspondence to Mr. Leandro Ryuchi Iuamoto, Human Structural Topography Discipline, Department of Surgery, Dr. Arnaldo Avenue, 455 Level 1, Sao Paulo, Brazil. Phone: (55 11) 3061.8277, e-mail: leandro.iuamoto@gmail.com

Abstract: Lectures and textbooks reading are the prevailing method of learning anatomy. The Clinical Anatomy League (CAL) of University of São Paulo Medical School (FMUSP) aims to complement this traditional method and also provide students with practical activities to enhance their anatomy knowledge. Our aim is to describe CAL's activities and analyze their impact on learning and knowledge retention by comparing members and nonmembers performance on a standardized assessment test. Student's interest in anatomy and their motivation and expectations towards CAL were also evaluated. Questionnaires about interest in anatomy, motivation and expectations to join CAL were answered by CAL's Introductory Course attendants. Later, a 20-question test based on important anatomical structures and their relations was applied to compare members' and nonmembers' performances. These students' grades on FMUSP Human Topography course was adopted as an indicator of baseline anatomical knowledge experience for further comparison. Students main motivation to become members was reviewing previously studied anatomy and learning surgical procedures. Their major expectations were to train surgical procedures and acquire new anatomical knowledge. Statistically significant changes on interest in anatomy were observed among introductory course attendants. CAL's members and nonmembers baseline grades were not statistically different, however members' performance on the study's exam was superior. Stratifications of the samples showed differences among subgroups according to their level in training. According to the analysis of obtained data, CAL succeeded in strengthening student's interest in anatomy as well as improving long-term retention of anatomical knowledge and may represent a successful initiative for enhancing anatomy's teaching.

Keywords: anatomy; health sciences; medical education; cadaver dissection; laboratory dissection; medical students

1. Introduction

Anatomy's essential role in medical practice and education is widely recognized (Eseonu et al., 2013; Fasel et al., 2005; Pandey and Zimitat, 2007; Papa V and Vaccarezza, 2013; Raftery, 2006; Turney, 2007) as well its importance for building a solid foundation for surgical learning (Eseonu et al., 2013). Recently, it was reported that anatomy teaching has been in decline for many years (Monkhouse, 1992; Pathiraja et al., 2014; Turney 2007) which lead the student's anatomical knowledge to become insufficient for satisfactory medical practice (McKeown et al., 2003; Prince KJAH et al., 2005). Traditionally, medical students learn anatomy basically by reading textbooks, attending lectures and practicing cadaver dissection. Recently, there were attempts to promote anatomy learning by the use of different approaches like employing imaging methods (e.g. ultrasound) due to their frequent use in clinical practice

(Hammoudi N et al., 2013; Ivanusic et al., 2010; Moore and Copel, 2011; Teichgraber et al., 1996; Tshibwabwa and Groves, 2005; Wittich et al., 2002), but those initiatives are rather punctual and the traditional model still prevails.

The Clinical Anatomy League of University of São Paulo Medical School (FMUSP) was founded in 2002 as an initiative to expand the learning of anatomy and to complement the knowledge obtained during medical training in FMUSP. In the context of FMUSP, the leagues can be defined as scientific nonprofit associations that aim to complement the academic learning in a specific area of medicine according to the institution basic tripod: research, education and extension programs (ABLAM - Associação Brasileira de Ligas Acadêmicas Médicas, 2014). In this regard, the Clinical Anatomy League is a extension program that promote activities such as lectures as well as embalmed and fresh cadaver dissection. While the lectures objectives are to promote the learning of basic anatomy and its

importance in medical practice, the cadaver dissection activities enable students' understanding of important anatomical structures relations in the human body as well as their learning about anatomical variations and the appliance of the anatomy knowledge in surgical procedures.

The purpose of this study is to describe the activities of the Clinical Anatomy League and analyze its impact on students learning and their interest in activities involving anatomy teaching.

2. Methods

1. The Clinical Anatomy League of University of São Paulo Medical School (FMUSP)

The FMUSP Clinical Anatomy League is composed by a group of students that, under the supervision of Human Structural Topography Discipline professors, aims to expand and consolidate anatomical knowledge. In order to achieve this purpose, the League offers lectures and practical activities to its members.

The lectures are based on teachers explaining of human anatomy topics, using both the blackboard and slide projection. After the lectures, the students participate in embalmed cadaver dissection under the guidance of professors at the FMUSP Anatomy Laboratory. During the dissection activities, the members are able to identify and revise important structures of the various human body systems (digestive, respiratory, urological, neurological, vascular, lymphatic and musculoskeletal). and can also apply the knowledge acquired during classes, as well as improve their dissection techniques.

Furthermore, the League also enables the members to attend surgical procedures, during which they can better understand how anatomy can be employed in medical practice and learn about pathologies that involve the systems' anatomy.

Finally, league members also perform fresh cadaver dissections monthly in small groups of students. During cadaver dissections, the members train surgical and dissection techniques related to the anatomical region being studied, with the aid of a supervising professor. The possibility of manipulating fresh organs and tissue is very enriching as embalmed cadaver's organs and tissue often present significant changes in their appearance and consistency.

In order to join the Clinical Anatomy League, interested students must attend the League's Introductory Course and undergo a test based on the topics discussed during the course. The classes are aimed at explaining regions' anatomy and topographical relations as well as physiopathological aspects of the most prevalent diseases involving these regions and their surgical treatment (focusing mainly on the surgical techniques).

The Clinical Anatomy league is open for students from the second up to the fourth year of medical school, and they may remain as members during this 2-year period, quitting in the end of the fourth year. Usually, the majority of the members are second-year students.

2. Assessment of impact on student's interest in anatomy and anatomical knowledge (first experiment)

2.1. Data extraction

In order to assess student's expectations, motivation in learning anatomy and interest in the league activities before and after the League's introductory course - which was composed by lectures and cadaver dissection presentations by former members - questionnaires were answered by the students who attended the introductory course (n=53) (Figure 1).



Figure 1: Questionnaire answered by the attending students

2.2 Exclusion criteria

Students who didn't attend the whole course (1 student) and who didn't fill the questionnaire adequately (1 student) were excluded from the study.

2.3 Data Analysis

After the course, 51 questionnaires were answered and considered eligible for further analysis (RR=96,2%). The data was analyzed on Minitab 16 Statistical Software. For difference significance analysis, Wilcoxon signed rank test was performed.

3. Assessment of knowledge retention (second experiment)

3.1 Data extraction

One year after the introductory course, a 20-question exam was applied in order to evaluate league members' anatomical knowledge and to compare it with nonmembers' performance. Thirty-three students agreed to take part in the study. Fourteen of them (42,4%) were league members - intervention group - and the remaining 19 (57,5%) were nonmembers who composed the control group.

The grades of both groups in medical school topographical anatomy course were taken as baseline for further comparison. The study's test grades of the two groups were used as a parameter for new anatomical knowledge acquisition (during league activities) and also for the assessment of long-term retention of knowledge obtained

previously to the experience in Clinical Anatomy League and enabled the comparison between the two groups.

3 Results

1. Motivation analysis

According the data obtained by the questionnaires of the first experiment, the interest of the majority of the students towards the League was related to learn further anatomy (34.7%) and surgical procedures (21.0%) - Figure 2.

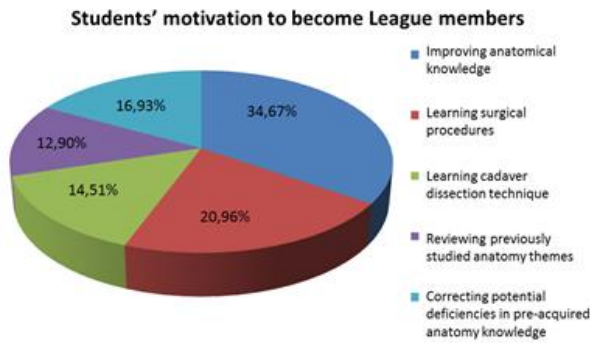


Figure 2: Students' interests on the league

Students expected that the League would provide surgical technique training (28.9%), enable participation in practical activities (24.0%), promote the acquisition and fixation of new anatomical knowledge (24.8%) and also the learning of anatomy topics relevant for clinical practice (22.3%) - Figure 3.

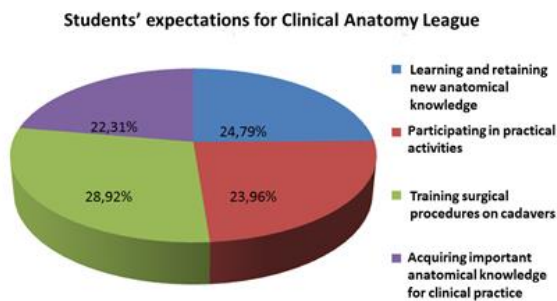


Figure 3: Students' expectations on the League

Moreover, the questionnaires pointed that student interest in anatomy before the introductory course was classified as: 29,4% "moderate", 49,0% "intense" and 21,5% "very intense" - Figure 4.

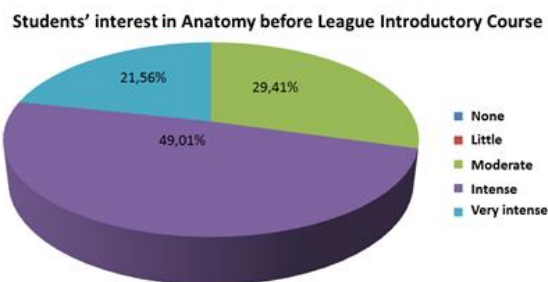


Figure 4: Interests of the students before the introductory course

After the course, the classification changed to following levels: 14% "moderate", 54% "intense" and 32% "very intense" - Figure 5. The difference was significant according to the result of Wilcoxon signed rank test ($P < 0.01$).

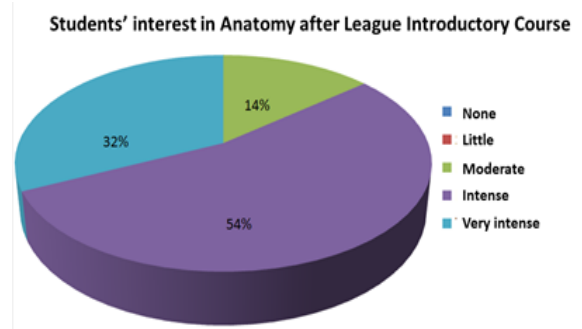


Figure 5: Interests of the students after the introductory course

2. Analysis of impact and performance on anatomy learning

In the second experiment the baseline grades and the grades on study's test were analyzed. The grades are shown in the following tables (Tables 1 and 2).

Table 1 - Control group baseline grades, test grades and grades variation

CONTR OL GROUP	Baseline Grade	Study's exam grade	Variation
1	8.00	6.0	-2.00
2	9.00	8.0	-1.00
3	8.10	7.5	-0.60
4	7.00	4.5	-2.50
5	8.50	8.5	0.00
6	8.75	9.5	0.75
7	9.80	8.5	-1.30
8	8.10	3.5	-4.60
9	7.30	4.0	-3.30
10	5.90	2.5	-3.40
11	7.50	4.0	-3.50
12	9.50	8.5	-1.00
13	8.40	4.5	-3.90
14	8.30	5.5	-2.80
15	7.50	4.0	-3.50
16	8.60	6.0	-2.60
17	8.35	4.5	-3.85
18	8.50	6.5	-2.00
19	9.25	7.0	-2.25

Table 2 - League members group baseline grades, test grades and grades variation

LEAGUE MEMBER S			
Student	Baseline Grade	Study's exam grade	Variation
1	7.50	6.50	-1.00
2	8.75	8.50	-0.25
3	9.00	8.00	-1.00
4	9.00	8.50	-0.50
5	9.50	10.00	0.50
6	8.00	3.50	-4.50
7	9.00	9.00	0.00
8	8.40	6.00	-2.40
9	10.00	7.00	-3.00
10	8.40	6.50	-1.90
11	6.00	7.00	1.00
12	9.50	7.50	-2.00
13	9.10	4.50	-4.60
14	9.10	7.50	-1.60

The mean baseline grade of the control group was 8.22 ± 0.92 and the league members' one was 8.66 ± 0.99 - Figure 6. No statistical significance was found when Student t-test was performed ($p = 0.100$).

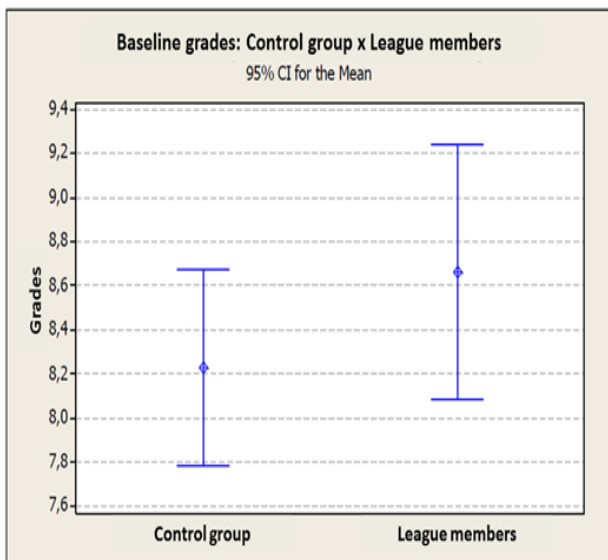


Figure 6: Baseline grades comparison of the two groups

When comparing the two groups performances, league members obtained a higher mean grade (7.14 ± 1.72) on the study's test in comparison with the control group (5.94 ± 2.05) and this result was statistically significant ($p = 0.04$) according Student's T test - Figure 7.

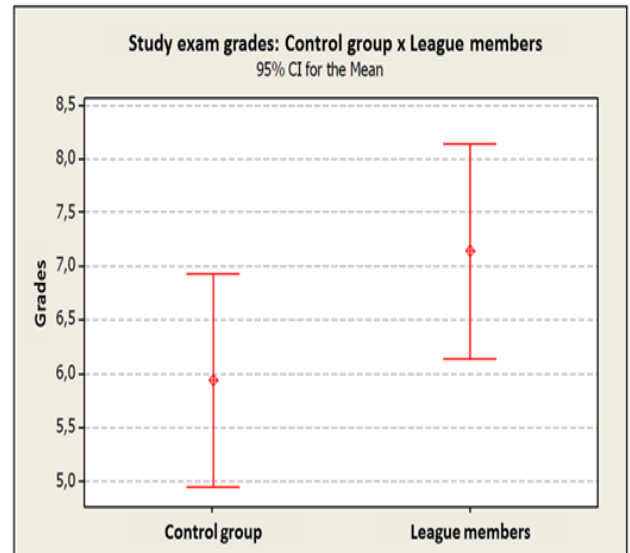


Figure 7: Study exam grades' comparison of the two groups

The test grades was lower than the baseline grades in both groups. The mean variation ("baseline grade" - "test grade") of the control group was -2.28 ± 1.48 and the one corresponding to league members was -1.52 ± 1.70 - Figure 8. The difference between this two variation was not statistically significant ($p = 0.174$).

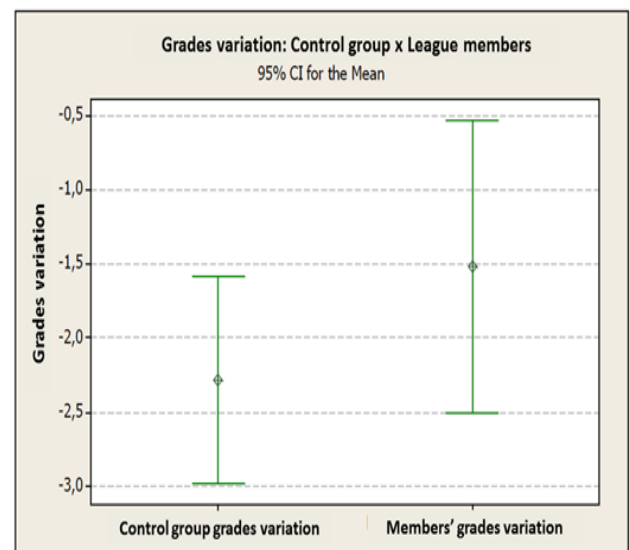


Figure 8: Grades' variation of Control group versus League members

The Human Topography course in the second year of medical training in FMUSP is the last formal contact of the students with a discipline exclusively dedicated to anatomy teaching. Due to the relevancy of this fact, a stratified analysis was necessary for a better understanding of the League's impact in students' anatomical knowledge as they advanced in their training and the period after attending Human topography course got longer. In order to perform this analysis, the two groups were stratified according to the categories "second year" and "other years" (referring to third and fourth year of medical school) - Table 3 and 4.

Table 3: Control group grades according to their level in medical training

CONTROL GROUP			
Student	Baseline Grade	Study's exam grade	Level in training
1	8.00	6.0	other years
2	9.00	8.0	second year
3	8.10	7.5	other years
4	7.00	4.5	second year
5	8.50	8.5	second year
6	8.75	9.5	second year
7	9.80	8.5	second year
8	8.10	3.5	other years
9	7.30	4.0	other years
10	5.90	2.5	other years
11	7.50	4.0	other years
12	9.50	8.5	other years
13	8.40	4.5	other years
14	8.30	5.5	other years
15	7.50	4.0	other years
16	8.60	6.0	other years
17	8.35	4.5	second year
18	8.50	6.5	other years
19	9.25	7.0	second year

Table 4: League members group grades according to their level in medical training

LEAGUE MEMBERS			
Student	Baseline Grade	Study's exam grade	Level in training
1	7.50	6.50	other years
2	8.75	8.50	second year
3	9.00	8.00	other years
4	9.00	8.50	second year
5	9.50	10.00	other years
6	8.00	3.50	second year
7	9.00	9.00	second year
8	8.40	6.00	other years
9	10.00	7.00	second year
10	8.40	6.50	second year
11	6.00	7.00	other years
12	9.50	7.50	second year
13	9.10	4.50	other years
14	9.10	7.50	other years

When control group baseline grades were compared according to their level in training, second year (n = 7) students had a mean baseline grade of 8.66 ± 0.88 while other years student (n = 12) mean baseline grade was 7.97 ± 0.88 - Figure 9. No statistically significant difference was found between the two subgroups (p = 0.059).

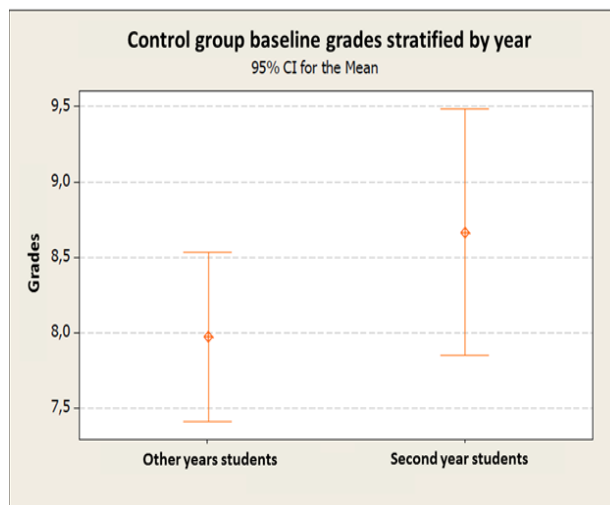


Figure 9: Comparison of control group baseline grades

However, when the study's test grade of the two subgroups was compared, a statistically significant difference was found (p = 0.018) indicating that second year students (who had recently attended Human Topography course) had a better performance on the test. The second year students subgroup had a mean grade of 7.21 ± 2.00 and the other years students subgroup mean grade 5.21 ± 1.76 - Figure 10.

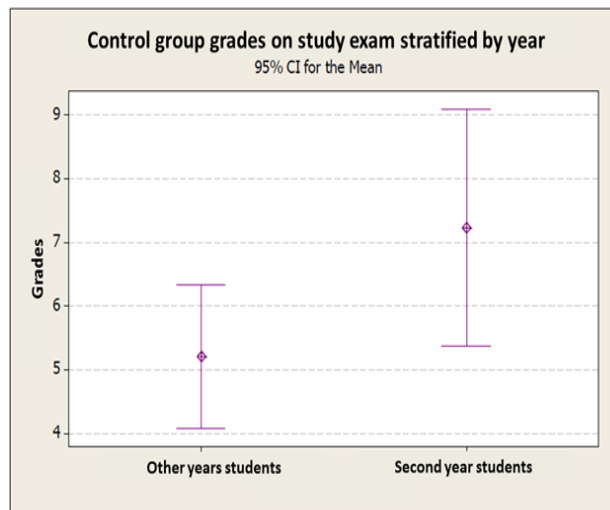


Figure 10: Comparison of control group study exam grades

The same analysis was carried out for the League members subgroups. Although second year students had a higher mean baseline grade (8.95 ± 0.66) than other years students (8.37 ± 1.23), the difference between them was not significant (p = 0.148) - Figure 11.

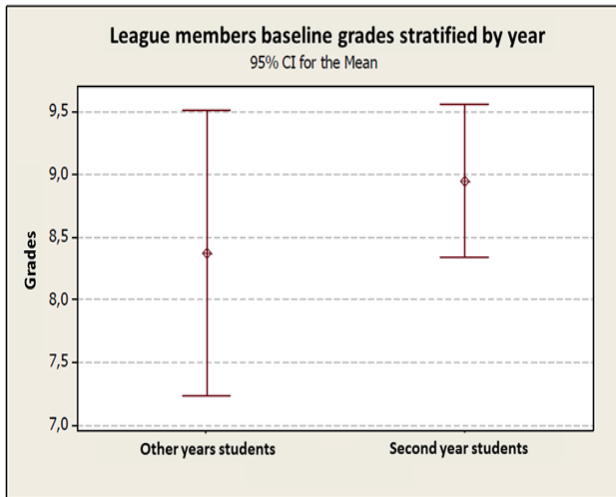


Figure 11: Comparison of League members baseline grades

As opposed to the results obtained from control subgroups test grades analysis, there was no significant difference ($p = 0.422$) between the second year and the other years students who composed the League members group. The second year students mean grade ($n = 7$) was 7.21 ± 1.87 and the other years students subgroup ($n = 7$) had a mean of 7.07 ± 1.72 - Figure 12.

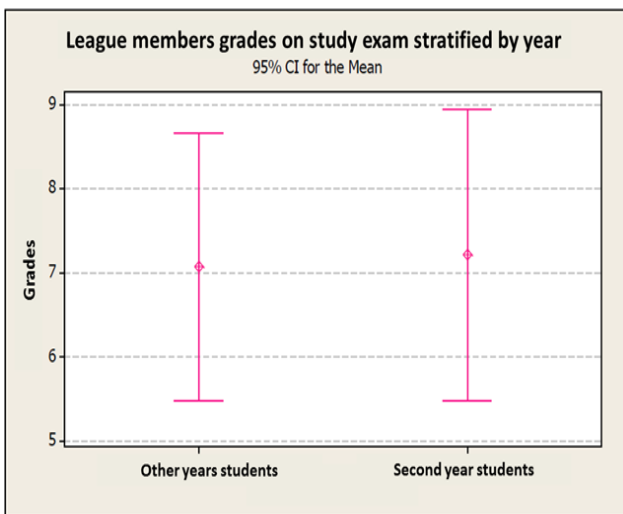


Figure 12: Comparison of League members study exam grades

The correspondent subgroups of control and league members group also had their baseline and test grades compared. The mean baseline grades of students from third and fourth years from control group ($n = 12$) and league members ($n=7$) were respectively 7.97 ± 0.88 and 8.37 ± 1.23 - Figure 13. They presented no statistically significant difference ($p = 0.212$).



Figure 13: Comparison of Non-second year students baseline grades

In contrast, the grades on the study's test taken one or two years (for third and fourth year students respectively) after the Human Topography course was statistically different ($p = 0.019$). League members achieved a higher mean test grade (7.07 ± 1.72) than control group (5.21 ± 1.76) - Figure 14.

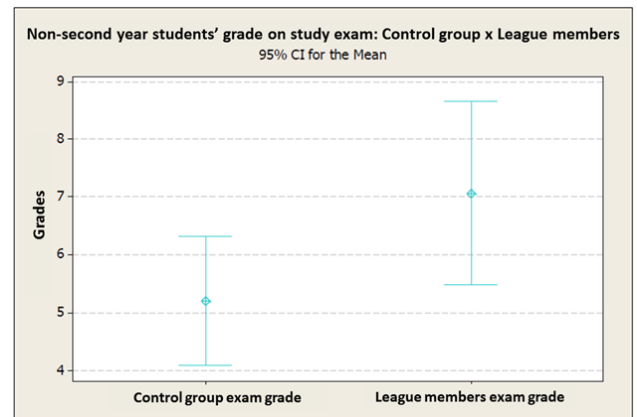


Figure 14: Comparison of Non-second year students study exam grades

Second year students from both control and league members groups baseline grades were compared. The students from control group had a mean baseline grade of 8.66 ± 0.88 while the mean baseline grade of those who belonged to the league members group was 8.95 ± 0.66 - Figure 15. No significant difference was observed ($p = 0.253$).

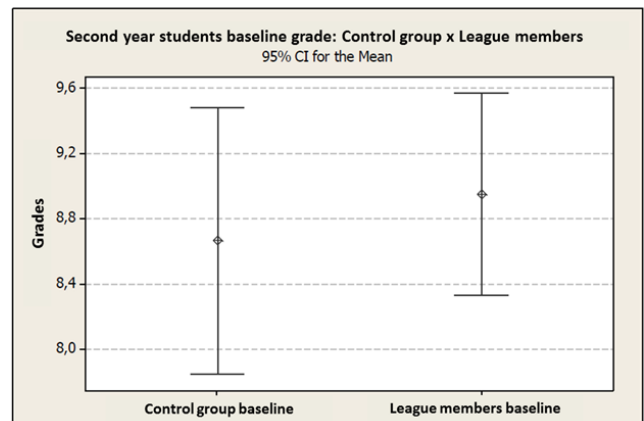


Figure 15: Comparison of Second year students

baseline grades

Second year students grades from both control and league members groups also did not present statistical difference ($p = 0.500$). Control group mean grade was 7.21 ± 2.00 and the one corresponding to league members group was 7.21 ± 1.87 - Figure 16.

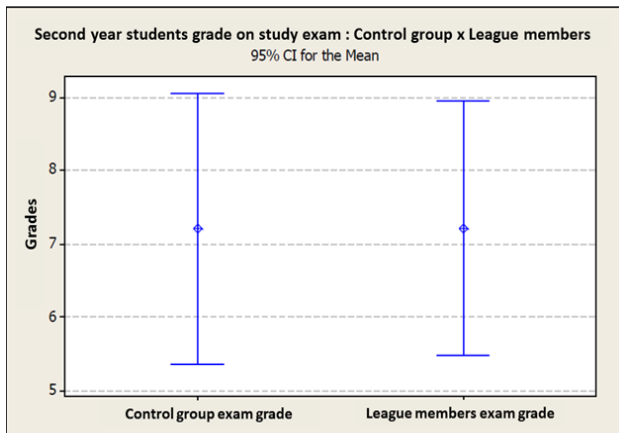


Figure 16: Comparison of second year students study exam grades

4 Discussion

Anatomy learning process is frequently associated with memorization, mainly through exhaustive textbook reading. Recent studies have suggested that the way Anatomy is currently taught at Medical School is rather inappropriate and the ability to reason and the ability to apply this knowledge is more important than structure names memorization (Pandey and Zimitat, 2007).

Through the analysis of the obtained data, it is possible to infer that the baseline of the control group and of the league members was fairly comparable (as seen in figure 6), even when the samples were stratified by years (figure 13 and 15). This finding probably reflect the fact that both groups attended the same courses in regular medical school curriculum when the baseline knowledge was set (in the second year of medical school, after completing Human Topography course).

Nonetheless, the performance of league members on the study's test was superior to the control group when both samples were not stratified (figure 7). When stratification was applied, there was a significant difference between the grades of third and fourth years from control and league members groups (figure 14), but this difference was not found among second year students from both groups, who presented a rather equivalent performance on the study's exam (figure 16). The comparison between second year students grades and those of the third and fourth years students from the same group showed that, in control group, second year students had a significantly better result on the exam than the other students (figure 10), but it did not happen in the league members group (figure 12). These findings corroborate with the hypothesis that the continuous

exposition to anatomy topics and anatomy-related activities in the league context is important for knowledge fixation and retention when the period after the completion of Human Topography course was longer (for third and fourth year students).

The combination of traditional methods of anatomy teaching (lectures) and more practical anatomy-related activities (embalmed cadaver dissection, surgical procedures training on fresh cadavers, assistance in surgeries) may represent a successful model to improve the anatomical knowledge and to make it more long lasting among the medical students. By the analysis of students' interests and motivations to become league members, it can be inferred that the practical approach to anatomical topics offered by the Clinical Anatomy League is critical for stimulating the interest of the students for anatomy. Medical students, mainly in the beginning of their training, are eager to apply the theoretical knowledge they acquire during regular classes in practical activities and this might help to explain why the Introductory Course of FMUSP Clinical Anatomy League arouse a higher interest in anatomy among its attendants.

In the context of the declining of anatomy teaching (Monkhouse, 1992; Pathiraja et al., 2014; Turney, 2007), innovative models as the one applied in FMUSP Clinical Anatomy League may represent a viable alternative to instigate the interest for anatomy among the medical students and to provide them with activities to satisfy their enthusiasm for hands-on training.

5 Conclusion

Several attempts to innovate and improve the teaching of anatomy have been taken worldwide. In this regard, the FMUSP Clinical Anatomy League illustrate an effective way of bringing the attention of the students to the importance of anatomy and its appliances in the various areas of Medicine. The results obtained in this study suggest that the League experience was able to improve long-term anatomical knowledge retention among its members when compared with students that did not participate in the League. Taking in consideration the relevance of anatomy in the context of Medicine, the long-term retention of anatomical knowledge may represent significant benefits for these students - not only during their training, but also in their professional practice.

Conflict of Interests

The authors declare that they have no conflict of interests.

References

- [1] ABLAM. Associação Brasileira de Ligas Acadêmicas Médicas: <<http://www.ablam.org.br/>>. Access in 26th july 2014.

- [2] Eseonu O, Carachi R, Brindley N. Case-based anatomy teaching: a viable alternative? *Clin Teach*. 2013 Aug;10(4):236-41.
- [3] Fasel JH, Morel P, Gailloud P: A survival strategy for anatomy. *Lancet* 2005, 365(9461):754.
- [4] Hammoudi N, Arangalage D, Boubrit L, Renaud MC, Isnard R, Collet JP, Cohen A, Duguet A. Ultrasound-based teaching of cardiac anatomy and physiology to undergraduate medical students. *Arch Cardiovasc Dis*. 2013 Oct;106(10):487-91.
- [5] Ivanusic J, Cowie B, Barrington M. Undergraduate student perceptions of the use of ultrasonography in the study of "livinganatomy". *Anat Sci Educ* 2010;3:318-22.
- [6] McKeown PP, Heylings DJA, Stevenson M, et al. The impact of curricular change on medical students' knowledge of anatomy. *Med Educ* 2003;37:954e61.
- [7] Monkhouse WS. Anatomy and the medical school curriculum. *Lancet* 1992;340:834e5.
- [8] Moore CL, Copel JA. Point-of-care ultrasonography. *N Engl JMed* 2011;364:749—57.
- [9] Papa V, Vaccarezza M. Teaching anatomy in the XXI century: new aspects and pitfalls. *ScientificWorldJournal*. 2013 Nov 7;2013:310348.
- [10] Pandey P, Zimitat C. Medical students' learning of anatomy: memorisation, understanding and visualisation. *Med Educ*. 2007 Jan;41(1):7-14
- [11] Pathiraja F, Little D, Denison AR. Are radiologists the contemporary anatomists? *Clin Radiol*. 2014 May;69(5):458-61.
- [12] Prince KJAH, Scherpbier AJAA, van Mameren H, et al. Do students have sufficient knowledge of clinical anatomy? *Med Educ* 2005;39:326e32.
- [13] Raftery A: Anatomy teaching in the UK. *Surgery* 2006, 25(1):1–2.
- [14] Turney BW. Anatomy in a modern medical curriculum. *Ann R Coll Surg Engl* 2007;89:104e7.
- [15] Tshibwabwa ET, Groves HM. Integration of ultrasound in the education programme in anatomy. *Med Educ* 2005;39:1148.
- [16] Wittich CM, Montgomery SC, Neben MA, et al. Teaching cardiovascular anatomy to medical students by using a handheld ultrasound device. *JAMA* 2002;288:1062—3.

Author Profile



Leandro Ryuchi Iuamoto, Graduate Student of University of São Paulo Medical School. He has experience in Medical Education, Thoracic Surgery (Lung Transplant) Gastroenterological (Pancreas Transplantation and Islets), General Surgery (Hernioplasty), Pediatric Cardiac Surgery, Surgical

Technique and Experimental Surgery, Acupuncture and Pain Management. He was also former President of Clinical Anatomy League of University of São Paulo Medical School (FMUSP) - Human Structural Topography Discipline, Department of Surgery, University of São Paulo Medical School.



Thiago Machado Nogueira, Graduate Student of University of São Paulo Medical School. Currently researching liver ischemic preconditioning and macronodular hyperplasia of the adrenal gland. Former Director of Academic Leagues of Hypertension and Clinical Anatomy FMUSP. Former member of the Surgical Technique Academic Leagues, Diabetes Control and USP Chronic Kidney Disease. He was also former Director of Clinical Anatomy League of University of São Paulo Medical School (FMUSP) - Human Structural Topography Discipline, Department of Surgery, University of São Paulo Medical School.



Brian Lucas Aguiar Sousa, Graduate Student of University of São Paulo Medical School. He was also former Director of Clinical Anatomy League of University of São Paulo Medical School (FMUSP) - Human Structural Topography Discipline, Department of Surgery, University of São Paulo Medical School.



Alfredo Luiz Jacomo, Associate Professor and responsible (regent) of Human Structural Topography Discipline, Department of Surgery, University of São Paulo Medical School (since 2011). Doctor of Science (Anatomy) by the Institute of Biomedical Sciences, University of São Paulo (1988). Post Doctorate in Anatomy of the Lymphatic System at the University of Buenos Aires. Head Teacher of Medical-Surgical Anatomy Laboratory LIM- 02 - University of São Paulo Medical School (2011 - 2013). He is also supervisor of the Clinical Anatomy League of University of São Paulo Medical School (FMUSP) - Human Structural Topography Discipline, Department of Surgery, University of São Paulo Medical School.