# Effect of Teaching Sessions Implementation on Performance of Internship Nursing Students Regarding Intra Osseous Access

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Received November 3, 2019, accepted December 15, 2019
doi: 10.47104/ebnrojs3.v2i1.110

## ABSTRACT

***Context:*** Intraosseous (IO) access is an emergency vascular access for providing venous administration of drugs and fluids in emergencies. Nurses are responsible for preparing and administering fluids and medications through IO access so that nurses should be aware of IO indications, contraindications, complications, and also practicing Intraosseous (IO) access insertion.

***Aim:*** The current study was conducted to assess the effect of teaching sessions implementation on the performance of internship nursing students regarding intraosseous access.

***Methods*:** A quasi-experimental (pre/post-test) design was unitized to conduct this study. The study recruited a convenient sample of fifty (50) internship nursing students. The Critical care lab at Faculty of Nursing Ain Shams University was used to conduct the teaching sessions. The study used two tools to achieve the aim of this study; Intraosseous Access Self-Administered Questionnaire and Internship Nurses' Practice Observational Checklist regarding intraosseous access.

***Results*:** After teaching session implementation regarding intraosseous access, there were statistically significant improvements in the level of performance of internship nursing students at P >0.05.

***Conclusion:*** Teaching session implementation had a statistically significant positive effect on internship nursing students' performance regarding intraosseous access. Repetitive training regarding IO access is recommended to be integrated as a part of the nursing faculty's clinical skills to ensure the highest standard of care in emergencies and to maximize skill retention.

***Keywords*:** Intraosseous access, internship nursing students, performance

## 1. Introduction

The intraosseous (IO) access is an alternative option for vascular access (IV) when peripheral intravascular access cannot be obtained, failed, inadequate, unlikely to be achieved, or would significantly delay critical treatment *(Strandberg, Larsson, Lipcsey, Michalek, & Eriksson, 2015).* Intraosseous (IO) cannulation is the insertion of a needle into a bone to allow the delivery of intravenous (medication) therapy in emergencies. In the peri-arrest situation, the intraosseous route should also be considered *(Jones, 2017).*

Many studies suggested that IO access is quicker than central venous access as the use of central venous catheters during resuscitation requires considerable skills and can lead to prolonged interruptions to chest compressions. Current recommendations are to establish IO access for critically ill patients if IV access is not possible or a delay in the first 2 minutes of resuscitation *(European Resuscitation Council, 2015).*

There are several situations where IV access can be challenging, and the intraosseous route can be used to solve the problem. All types of physiological shock, hypothermia, multiple previous intravenous lines, or intravenous drug use are everyday situations where IO access has proven valuable *(American Heart Association, 2016).* IO access can deliver fluids as quickly as an IV method. The flow rates average 5L/hr., 3 seconds to heart with medication/fluids. Drugs and blood can be administered through IO infusion, but the pressure will be needed to achieve reasonable flow rates using a pressure bag or a 50 ml syringe. Onset and peak drug levels are similar to IV administration, lower insertion and infusion pain, and less medication required for pain management *(Sezer, 2018).*

Furthermore, it can be used to aspirate blood samples such as Glucose, hemoglobin, and electrolytes on initial placement. In addition to all resuscitation and anesthetics, drugs can be safely given via the IO route *(Hinkle & Cheever, 2018).* Contra-indications of intraosseous access (IO) include the following conditions: fracture or prosthesis in the targeted bone, signs of infection at the insertion site, inability to locate landmark, recent IO (past 24-48 hrs.) in the same limb (previous failed attempt) *(Amy & Collins, 2015).*

Complications associated with IO access involved extravasations due to the displacement of the needle, embolism, chipping of the bone during insertion site, pain related to infusion of drugs/fluids, and infection *(Afzali, Kvisselgaard, Lyngeraa, & Viggers, 2017).* According to *Schmutz, Eppich, Hoffmann, Heimberg, and Manser (2014),* there are several insertion points described for adult IO access, like humeral head with the elbow bent, and the patient's hand on their abdomen. The nurse should be palpate the surgical neck of the humerus to locate the

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greater tuberosity. Also, proximal tibia below the patella, the nurse should palpate the tibial tuberosity and ensure the feeling of bone below subcutaneous tissue. Besides, distal tibia, the nurse must palpate the most prominent aspect of the medial malleolus, as well as the anterior and posterior borders of the tibia.

Teaching session implementation regarding intraosseous access gives insight to nursing students about IO access included: it's definition, indications, contraindications, complications, technique and nursing role before, during and after intraosseous access insertion based on recent medical and nursing knowledge derived from (*Resuscitation Council the United Kingdom, 2015; American Heart Association (2016).* Intra-osseous access can be taught to nursing students through the implementation of the teaching session, providing reality, complexity, and unstructured conditions that are not easily found in other educational, clinical interactions *(Sezer, 2018).*

## 2. Significance of the study

Early intravenous (IV) access in emergencies is vital for critically ill adult patients, and any delays could have a significant impact on survival chances *(Afzali et al., 2017).* The European Resuscitation Council (ERC), and the American Heart Association (AHA) recommended the use of IO access in cardiac arrest if the peripheral venous catheter is not accessible *(Kleinman et al., 2015; Nolan et al., 2015).* So, this study aimed to assess the effect of teaching session implementation on the performance of internship nursing students regarding intraosseous access.

## 3. Aim of the study

The present study aimed to assess the effect of teaching sessions implementation on the performance of internship nursing students regarding intraosseous access through the following:

- Assessing the knowledge and practice of internship nursing students regarding intraosseous access.
- Developing and implementing teaching sessions regarding intraosseous access.
- Evaluating the effect of teaching session implementation regarding intraosseous access on knowledge and practice of internship nursing students.

### 3.1. Research Hypotheses

It was hypothesized that

- The teaching session implementation regarding intraosseous access would lead to a significant positive improvement in knowledge of internship nursing students compared to their pre-teaching level.
- The teaching session implementation regarding intraosseous access would lead to a significant positive improvement in the practice of internship nursing students compared to their pre-teaching level.

## 4. Subjects & Methods

### *4.1. Research design*

a quasi-experimental (pre/post-test design) used to achieve the aim of this study to test the effect of teaching session implementation on the performance of internship nursing students regarding intraosseous access. Quasi-experimental research is comparable to experimental research that an independent variable is manipulated. It is distinct from experimental research because there is either no control group, no random selection, no random assignment, or no active manipulation *(LoBiondo-wood & Haber, 2017).*

### *4.2. Research Setting*

Critical care lab at Faculty of Nursing Ain Shams University. This lab consists of 5 beds with five advanced mannequins and also contains other medical devices such as monitors, mechanical ventilators, IV holder, and all the required instruments. The lab capacity can train 50 students at the time.

### *4.3. Subjects*

A convenient sample of 50 internship nursing students was included in the study. The sample size was calculated according to the total number of internship nursing student in the current year 2019 was 182 and based on the following assumption:

$$n = \frac{t^2 \times p(1-p)}{m^2}$$

n = the required sample size
t = the confidence level at 95% (standard value of 1.96)p = estimated prevalence of teaching problems among internship nursing students.
m = the margin of error at 5% (standard value of 0.05).

### *4.4. Tools of the study*

#### 4.4.1. Internship Nurses' Intraosseous Access Self-Administered Questionnaire

It developed by the researchers and consisted of two parts. The first part is concerned with demographic data of internship nursing students such as age, gender, marital status, qualifications, years of experience (for technical nurses), and training courses. The second part is concerned with internship nursing students' knowledge regarding intraosseous access. It consisted of five subsections, including a total of 26 MCQs.

The five subsections encompassed knowledge regarding intraosseous access included, such as definition, indications, contra-indications, complications (8 questions). The second subsection included knowledge regarding the nursing role before intraosseous access insertion such as patients' preparation, the precaution of infection control, IO equipment's preparation (5 questions).

The third subsection involved a nursing role during intraosseous access insertion such as site sterilization, uses of bone marrow aspiration, serious signs of displacement, the flow rate of administered fluid, and possible drug

administration (5 questions). The fourth subsection is concerned with the nursing role after intraosseous access insertion. It included knowledge related to accidental avoidance of removal of IO cannula, signs of circulation improvement, checking the effectiveness of IO cannula (5 questions). The fifth subsection included knowledge related to the nursing role after intraosseous access removing. It included (3 questions), and it was derived from reviewing the literature *(Nolan et al., 2015; Afzali et al., 2017)*.

*Scoring system*

Each question was scored as (1) mark for the correct answer and (zero) for the incorrect answer with a total score of 26 marks. The scores of the items in each subgroup were summed-up and the total divided by the number of items, giving a mean score for each subgroup. The total mean for internship nursing students' knowledge was categorized into satisfactory or unsatisfactory as follows:

- <90% was considered unsatisfactory level, it was referred to <23 degrees).
- ≥ 90% was considered as a satisfactory level. It was referred to ≥ 23 degrees).

### 4.4.2. Internship Nurses' Practice Observational Checklist

It was developed by the researchers to assess the interns' practice regarding intraosseous access. It was derived from reviewing literature *Jones, (2017)*; *Zdain (2017).* Nurses' observational checklist regarding intraosseous access, including four checklists regarding preparation before the procedure (12 steps), care during the procedure (6 steps), observation after insertion (14 steps), and the removal of IO cannula (14 steps).

*The scoring system*

Each procedural step was given (1) mark for the step that is correctly done, and (zero) for incorrectly done or not done, with a total score of 46 marks. A subtotal score of practice was distributed as follows:

- Preparation before the procedure (12 scores).
- Care during the procedure (6 scores).
- Observation after insertion (14 scores).
- Removing the IO cannula (14 scores).

The scores of the items in each checklist were summed-up, and the subtotal score is divided by the number of items, giving a mean score for the subgroup. The total mean for internship nursing students' practice was categorized into satisfactory or unsatisfactory as follows:

- <90 % was considered not competent; it was <41 score).
- ≥ 90 % was considered competent. It was ≥a 41 score).

### *4.5. Procedures*

The tool validity testing was reviewed by a panel of seven experts from medical-surgical and critical care nursing staff at the faculty of nursing Ain Shams University to ascertain their face and content validity. Testing reliability of proposed tools was done statistically by alpha-Cronbach test for internship nursing students' knowledge of intraosseous access (tool 1) was (0.882), and for internship nursing, students' observational checklists (tool 2) was (0.806) that indicate high reliability of the used tools.

The researcher obtains the necessary official approvals from the Dean and administrators of the Faculty of Nursing, Ain Shams University, for conducting the study.

Ethical consideration: The researcher explains the aim of the study to each internship nursing students, and the written consent was taken for the participation of the study.

A pilot study was carried out on 10% of the total number of the study sample to test the applicability, clarity, and efficacy of the tools, and the feasibility of the research process. Then, the tool was modified according to the results of the pilot study. Those internship nursing students were excluded from the study.

Fieldwork: The tools were developed by the researchers based on reviewing recent and relevant literature. Data collection for this study was carried out in the period from July to September 2019. The methods of teaching used were theoretical and practical sessions, followed by focus group discussions in addition to audiovisual materials and demonstration and re-demonstration.

Once the approval was taken to carry out the study, the researchers started to collect data and implement the teaching sessions in the following way:

In the beginning, the researchers prepare the lab and the equipment necessary for the upcoming planned IO procedure. All internship nursing students received the pre-test for knowledge and practice assessment. Internship nursing students filled the knowledge assessment tool for pre-test and post-test within 45 minutes. The observational checklist was filled by researchers to assess each internship nursing student practice of intraosseous access within 30 minutes.

Internship nursing students are given a booklet about intraosseous access. They were divided into four subgroups. Each subgroup involved ten students and had two sessions through 2 days per week (one session for theory and the other for practice), whereas each session took four hours. This rule continued for each group until all interns were trained. This phase consumed one and a half month

The researcher developed the Intra Osseous Access Booklet in the English language, based on recent medical and nursing literature derived from *Resuscitation Council United Kingdom (2015); American Heart Association (2016).* It gives insight into IO access regarding its' definition, indications, contraindications, complications, technique, and nursing role before, during, and after intraosseous access insertion.

The first session was directed toward theoretical knowledge content about definition, indications, contraindications, complications, and technique of intraosseous access. It was given for four hours.

The second session was directed toward practical content through demonstration and re-demonstration of IO access. It was given for four hours.

The effectiveness of teaching sessions was evaluated through a post-test (taken about one month) to evaluate the internship nursing students' performance of intraosseous

access, which was carried out by using the self-administered interview questionnaire and observational checklist after one month from teaching session implementation.

Methods of teaching: PowerPoint presentation is used to give a higher possibility of tasks being completed on time as well as a more significant potential for the lesson to be executed as planned. Also, demonstration and re-demonstration for practice for each group of subjects to share their skills; therefore, it enhances their performance. The teaching media used were illustrated booklet and video film.

### *4.6. Data analysis*

All the collected data were coded, tabulated, and subjected to statistical analysis. Statistical analysis is made by statistical package SPSS. Also, Microsoft Excel is used for data handling and graphical presentation. The quantitative variable is described by the mean, standard deviation (SD), while qualitative categorical variables are described by percentage and proportions. Descriptive statistics were used to analyze the response to individual items and the respondents' characteristics. Paired T-test used to test the difference between pre, and post-test and r test used to test correlation.

## 5. Results

Table 1 demonstrates the frequency and percentage distribution of demographic characteristics of the internship nursing students under study. The mean age of the studied interns was 20.0±1.03, and 70% of them their age from 20-<22 years, according to their gender 88.8% were females, 92.0% of them were single, freshmen, and had no experience. Besides, all of them did not receive training courses regarding intraosseous access.

Table 2 reveals statistically significant improvement between the mean score of internship nursing students' knowledge regarding intraosseous access after teaching session implementation compared to their pre-implementation level at P ≤0.00.

Figure 1 illustrates the percentage distribution of a satisfactory level of total knowledge regarding intraosseous access pre and post-teaching session implementation among internship nursing students. It reveals that the majority of 90% of the studied sample had a satisfactory level after the implementation of a teaching session regarding intraosseous access compared to 0% before implementation.

Table 3 demonstrates the differences between mean scores of internship nursing students' practice regarding intraosseous access pre and post-teaching session implementation. It shows statistically significant improvement in the internship nursing students' practice after implementation of the teaching session compared to their pre-teaching session implementation level at P ≤0.00.

Figure 2 illustrates the percentage distribution of the satisfactory level of total practice of internship nursing students' pre and post-teaching sessions implementation. It showed that the majority of the studied sample, 96% had a satisfactory level of practice after teaching session implementation regarding intraosseous access compared to 0% before teaching session implementation.

Table 4 shows the correlation between total knowledge and total practice of internship nursing students regarding interosseous access. It illustrates a significant strong positive correlation between total knowledge and practice.

**Table (1): Frequency and percentage distribution of the demographic characteristics of internship nursing students under study (no. =50).**

| Sociodemographic characteristics | No. (50) | % |
|---|---|---|
| **Age group (years** | | |
| 20-<22 | 35 | 70.0 |
| 22-<24 | 11 | 22.0 |
| 24-<25 | 4 | 8.0 |
| Mean± SD | 20.0±1.03 | |
| **Gender** | | |
| Male | 6 | 12.0 |
| Female | 44 | 88.8 |
| **Marital status:** | | |
| Single | 46 | 92.0 |
| Married | 4 | 8.0 |
| **Qualifications** | | |
| Freshmen | 46 | 92.0 |
| Technical health institute graduate | 4 | 8.0 |
| **Years of experience** | | |
| Yes | 46 | 92.0 |
| No | 4 | 8.0 |
| **Receiving IO training courses** | | |
| Yes | - | 0.00 |
| No | 50 | 100.0 |

**Table (2): Comparison of pre and post-test mean knowledge score of the internship nursing students regarding intraosseous access.**

| Knowledge elements | Correct answer | | Paired t-test | p-value |
|---|---|---|---|---|
| | Pre-test | Post-test | | |
| knowledge regarding intraosseous access | 2.00±1.1 | 7.6±0.4 | 7.08 | 0.001 |
| nursing role before intra osseous access insertion | 0.32±0.005 | 4.5±0.23 | 5.20 | 0.000 |
| nursing role during intra osseous access insertion | 0.24±0.001 | 4.2±0.07 | 4.92 | 0.007 |
| nursing role after intraosseous access insertion | 0.27±0.00 | 4.6±0.03 | 4.37 | 0.002 |
| nursing role after intraosseous access removal | 0.31±0.002 | 2.6±0.03 | 4.02 | 0.000 |
| **Total knowledge** | 3.14±1.108 | 23.5±0.76 | 7.08 | 0.001 |

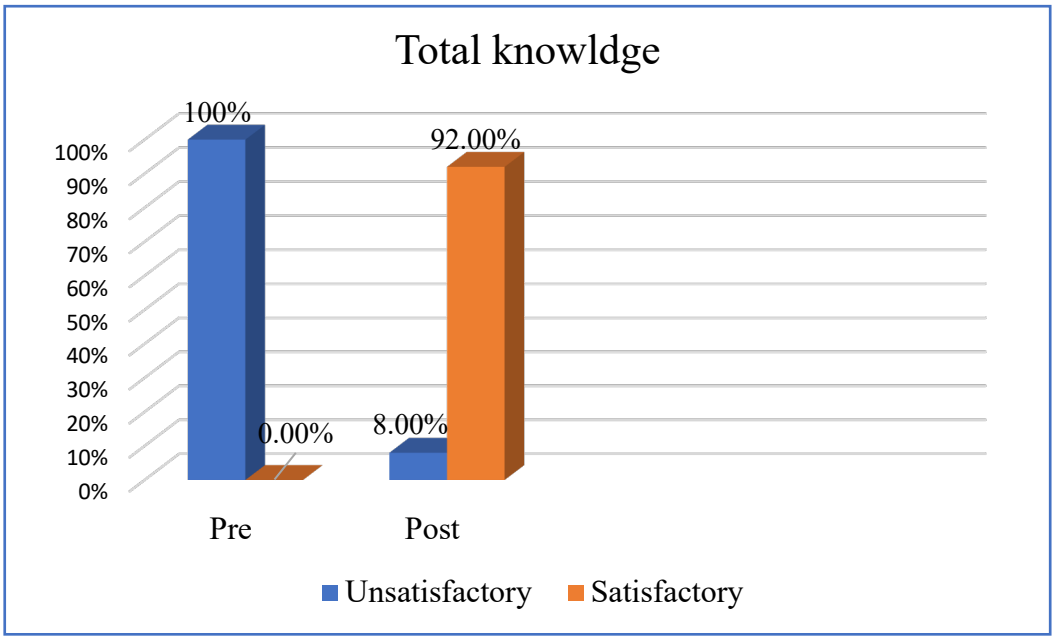


**Figure (1): Percentage distribution of interns' satisfactory level of total knowledge regarding intraosseous access (no=50).**

**Table (2): Comparison of pre and post-test mean practice scores of the internship nursing students regarding intraosseous access.**

| Nursing procedures | Correct answer | | Paired t-test | p-value |
|---|---|---|---|---|
| | Pre-test | Post-test | | |
| Preparation before procedure | 0.02±0.001 | 11.3±0.35 | 8.53 | 0.000 |
| Care during procedure | 0.00±0.0014 | 5.4±0.36 | 10.05 | 0.000 |
| Observation after insertion | 0.002±0.00 | 13.1±0.7 | 12.24 | 0.000 |
| Removing IO cannula | 0.00±0.00 | 13.6±0.39 | 14.91 | 0.000 |
| **Total practice** | 0.02±0.00 | 43.4±1.8 | 17.5 | 0.000 |

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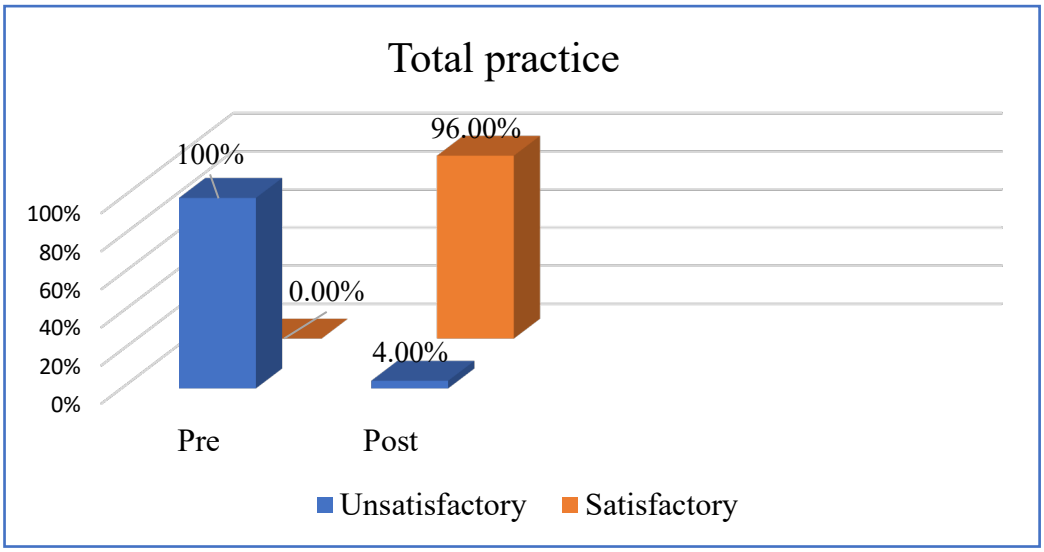


**Figure (1): Percentage distribution of interns' satisfactory level of total practice regarding intraosseous access (no=50).**

**Table (4): Correlation between total knowledge and practice of internship nursing students regarding intraosseous access (n. = 50).**

| Variables | Total practice. | |
|---|---|---|
| | r test | P-value |
| Total knowledge | .764 | .000 |

## 6. Discussion

Internship nursing students trained in hot areas such as emergency and critical care units facing intraosseous access without awareness of its insertion technique, indication, contraindication, nursing care pre, during, and post. The researcher conducted the current study to assess the effect of teaching sessions implementation on the performance of internship nursing students regarding intraosseous access.

Regarding the percentage distribution of demographic data of the internship nursing students under study, there were more than two-thirds of them their age from 20-< 22 years. From the researchers' point of view, this related to that the studied sample are newly graduated internship nursing student and still trained under supervision. This result was similar to *Afzali et al. (2017)* entitled **"**Intraosseous access can be taught to medical students using the four-step approach." The study reported that the majority of the studied sample their age between 22-24 years.

Concerning gender majority of the studied subject were females, this related to the more significant fraction of the nurses in Egypt were females and may also be related to the studying of nursing in Egypt were exclusive for females only till a few years ago. This result agreed with *Zdain (2017),* who did a study entitled "Nursing care regarding post-intraosseous access insertion in the critical care unit," and it was found that most of the studied sample were females.

Regarding marital status and years of experience, the majority of the studied sample was single and had no experience. This finding may be because they were a new graduate, and most of them are freshmen. Only a small percentage of them had continued their BSC degree after graduation from technical health institute, so they are licensed and already worked beside their education in the faculty of nursing. This result supported by *Viggers, Olsen, and Afzali (2015),* who conducted a study entitled "Students' society for anesthesiology and traumatology" and found that the majority of the studied sample included in their study were single and had no experience regarding intraosseous (IO) access.

One of the notable findings was that all internship nursing students under the study did not receive training courses about intraosseous access, this may be due to intraosseous (IO) access consider recent adult Advanced Life Support (ALS) procedure for cases in which intravenous access is difficult or unavailable. These results contradicted with *Jones (2017)***,** who conducted a study entitled "adult intraosseous access cannulation protocol using the EZ device for emergency intravascular access." They mentioned that the majority of the studied sample received training courses, and they were able to practice adult intraosseous access cannulation, use intraosseous cannula or remove intraosseous cannula easily without complications after implementation intraosseous access cannulation protocol.

Concerning differences between mean scores of internship nursing students' knowledge regarding intraosseous access pre and post-teaching session implementation, the present study revealed an improvement

in the internship nurses' students' knowledge regarding IO post teaching session implementation compared to their pre-intervention level. This result agreed with *Santos, Carron, Yersin, and Pasquier (2013)*, who conducted a study entitled "EZ-IO intraosseous device implementation in a pre-hospital emergency service." The study reported that intraosseous access could be taught to medical students by an objective structured clinical examination (OSCE) in order to enhance their knowledge and learning clinical outcomes.

Concerning the satisfactory level of total knowledge regarding intraosseous access pre and post-teaching session implementation among internship nursing students, the present study revealed that the majority of internship nursing students had a satisfactory level of total knowledge after teaching session implementation. From the researchers' point of view, lack of nursing students' knowledge regarding IO pre-teaching session implementation may be due to lack of training courses about IO, and lack of experience. It is also not included in the undergraduate program of the studied setting.

This result in the same line with *Dolister et al. (2013)*, who conducted a study entitled **"**Intraosseous vascular access is safe, effective and costs less than central venous catheters for patients in the hospital setting," and reported that there was an improvement in nurses' knowledge post implementations of educational, supportive program. This finding is supporting the first research hypothesis.

As regards differences between mean scores of internship nursing students' practice of intraosseous access pre and post-teaching session implementation, the results of the present study revealed that there was an improvement in the internship nurses' students' practice regarding IO post teaching session implementation than pre-intervention level. From the researchers' point of view, poor internship nursing students' practice pre-teaching session implementation might be due to lack of training and deficiency of this subject in the undergraduate nursing curriculum.

This result was supported by *Lewis and Wright (2015),* who conducted a study entitled "Saving the critically injured trauma patient: a retrospective analysis of 1000 uses of intraosseous access" and mentioned that there was an improvement in nurses' practice post implementations of the teaching session.

Concerning the satisfactory level of total practice regarding intraosseous access pre and post-teaching session implementation among internship nursing students, the present study revealed that the majority of internship nursing students had a satisfactory level of total practice after teaching session implementation. This finding might be due to a lack of exposure to such procedures during their clinical training. This result in the same line with *Bradburn, Gill, and Doane (2015),* who conducted a study entitled "Understanding and establishing intraosseous access" and reported that there was an improvement in nurses' practice post-training program. This finding was supporting the second research hypothesis.

Finally, the results of the study also revealed a strong positive correlation between the total knowledge and total practice of internship nurses' students. This finding may be due to the effect of the teaching session that enhances knowledge of internship nursing students and consequently improves their practice.

## 7. Conclusion

Based on the finding of the current study. It was concluded that teaching session implementation had a statistically significant positive effect on internship nursing students' performance (knowledge and practice) regarding intraosseous access**.**

## 8. Recommendations

- Repetitive training in performing IO access to be integrated as a part of the nursing faculty's clinical skills to ensure the highest standard of care in emergencies and to maximize skill retention.
- In-service training courses should be provided to internship nursing students in order to keep their knowledge and practice updated regarding IO access.
- Emergency and critical care units should be supplied by a protocol about nursing care for patients with intraosseous access.

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