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Research Article

### A CROSS-SECTIONAL STUDY OF KNOWLEDGE AND PRACTICE OF DENTAL LOCAL ANAESTHESIA AMONG UNDERGRADUATE DENTAL STUDENTS AND DENTAL INTERNS IN SAUDI ARABIA

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**Abstract:**

**Background:** Local anaesthetics are known to be the most commonly used drugs in dentistry and the backbone of pain control. Proper dental local anaesthetic knowledge and practice are vital aspects of student learning and are essential to provide the most optimal patient care. **Aims and Objectives:** This study aimed to assess the knowledge and practice of dental local anaesthesia among undergraduate dental students and dental interns. **Material and Methods:** A cross-sectional study of 422 subjects (36% males and 66% females). Questionnaires were distributed then collected at Riyadh Elm University, Riyadh, Saudi Arabia. **Statistical analysis:** Data was transferred to SPSS version 20.0 for statistical analysis. The frequency test was mainly used along with correlation tests, which were Chi test, Spearman's correlation, and Pearson's correlation. **Results:** Knowledge of local anaesthesia was high except in familiarity with local anaesthesia reversal. The practice of topical and local anaesthesia was high in all specialties except periodontics. The use of one to two cartridges (73%) and injection time between 10 to 30 seconds (49%) were most prevalent. Local anaesthesia safety practice was high except in maximum dose calculation. Infiltration (80%) was the most common technique in the maxilla, and nerve block (63%) was the most common technique in the mandible. There were no difficulties with local anaesthesia administration in maxilla (56%) and a slight difficulty in mandible (38%); however, both were very effective (46%). 84% of the subjects faced local complications while 64% had systemic complications. Confidence in managing local and systemic complications was moderate at 37% and 31%, respectively. **Conclusion:** Dental students and interns demonstrated high knowledge of different dental local anaesthesia aspects. Dental local anaesthesia practice showed various patterns.

**Key-words:** Local Anaesthesia; Knowledge; Practice; Dental; Students; Saudi Arabia

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**INTRODUCTION:**

Treating patients with minimal discomfort and pain has always been paramount in dentistry and continues to grow in necessity with the array of contemporary techniques and devices in our armamentarium. (1, 2) Poorly managed pain control can instigate fear and negative response in patients, which becomes an obstacle for clinicians to create a positive overall patient experience. (3) Thus, pain control is one of the most important parts of dentistry. (4) The prevention and elimination of pain during dental treatment have benefited patients and doctors, enabling the dental profession to make tremendous therapeutic advances that would otherwise have been impossible. (5) To prevent pain, dentists administer local anaesthesia, mainly via needle injection. (6) Local anaesthetics are known to be the most commonly used drugs in dentistry as they are considered the backbone of pain control. (7, 8) One of the essential skills required of all dental practitioners is the ability to provide safe and effective local anaesthesia. (9) Proper dental local anaesthetic knowledge and practice are essential to provide the most optimum treatment. Many dental students feel insufficiently prepared in regards to local anaesthesia. (10, 11) This feeling may still be present after graduation, as recently graduated dentists claim that local anaesthesia courses do not provide adequate preparation for the initial demands of general practice. (8, 12) In this study, we are assessing the knowledge and practice of dental local anaesthesia among undergraduate dental students and dental interns.

**MATERIAL AND METHODS:**

First, Institutional Review Board (IRB) approval was obtained from Riyadh Elm University (REU), Riyadh, Saudi Arabia (Ethical Approval Number: RC/IRB/2018/1295). Second, male and female dental students in fifth year, sixth year, and dental interns were reached in REU's classes, labs and clinics. Third, cross-sectional study was initiated via questionnaires that were distributed to all participants, and information were given to clarify all parts of the questionnaire. Exclusion criteria were applied to exclude all participants who did not sign the consent form, questionnaires with incomplete data, participants who were not enrolled in REU, or students who were in the first, second, third, or fourth year since they had not had adequate experience regarding local anaesthesia.

The questionnaire contained two major parts. The first part contained three main points which were the Consent Form (Agree or Disagree), Gender (Male or Female) and Year (Year 5, Year 6, or Dental intern).

The second part contained 25 questions which targeted local anaesthesia knowledge and practice.

Eight (Yes or No) questions that assessed knowledge and familiarity with maximum dose calculation, pre-anaesthesia aspiration, scoop technique, post-anaesthesia instruction, components of the dental syringe, ingredients of the anaesthetic solution, local anaesthesia contraindications, and the concept of local anaesthesia reversal.

Eight questions were in the form of a five-point Likert scale (Always, Very often, Sometimes, Rarely, Never), which assessed the practice tendency of using topical anaesthesia, local anaesthesia in different specialties: "Periodontics, Restorative, Prosthodontics, Endodontics, Surgery", different local anaesthesia administration techniques: "Infiltration, PDL injection, Nerve block" in the maxilla, different local anaesthesia administration techniques: "Infiltration, PDL injection, Nerve block" in the mandible, post-anaesthesia instructions, maximum dose calculation, and pre-anaesthesia aspiration.

There were five questions in the form of a 5-point Likert scale (Extremely, Very, Moderately, Slightly, Not at all) which addressed the difficulty of providing local anaesthesia in the maxilla, difficulty of providing local anaesthesia in the mandible, effectiveness of local anaesthesia, confidence in managing local complications, and confidence in managing systemic complications resulting from local anaesthesia administration.

There was one question to evaluate the average number of cartridges used (Less than one, One to two, Three to four, More than four). One question evaluated the time required to administer local anaesthesia (Less than 10 seconds, 10 to 30 seconds, 30 to 60 seconds, More than 60 seconds). One multiple response question assessed past personal experience of local complications resulting from local anaesthesia (None, Failure to obtain anaesthesia, Pain on injection, Needle-stick injury, Hematoma, Edema, Burning on injection, Paresthesia, Infection, Needle breakage, Facial nerve paralysis, Trismus, Postoperative intraoral lesions, Sloughing of tissue or soft tissue injury, or/and Visual disturbance).

Lastly, one multiple response question assessed past personal experience of systemic complications resulted from local anaesthesia (None, Dizziness, Syncope, Anaphylaxis, Hyperventilation, Overdose toxicity, Drug interaction, Nervous system complications, Palpitation or intravascular injection, Other cardiac complications, Other respiratory complications, or/and Idiosyncrasy).

For the statistical analysis, all questionnaires were collected, and data was transferred to SPSS version

20.0 (IBM Corporation Armonk, New York, US) for statistical analysis. A frequency test was mainly used to analyse the answers for each question statistically. Additionally, the Chi-square test was used to test for correlation between nominal variables. Spearman's correlation was used to test for correlation between ordinal variables or ordinal and nominal variables. Pearson's correlation was used to test for correlation between quantitative variables and nominal or ordinal variables. A P value of <0.05 was considered statistically significant.

## RESULTS:

In our study, the number of participants was 422, of which 34% were male (145/422), and 66% were

females (277/422). The level of education "Years" of the subjects was 30% Year 5 (126/422), 51% Year 6 (217/422), and 19% Interns (79/422).

Regarding knowledge of local anaesthesia, various knowledge aspects were targeted, including maximum dose calculation, aspiration step, scoop technique, post-operative instructions, components of the dental syringe, ingredients of the anaesthetic solution, local anaesthesia contraindications, and the concept of local anaesthesia reversal. The subjects' familiarity with knowledge aspects was remarkably high, except in familiarity with the concept of local anaesthesia reversal [Table 1].

[Table 1]: Assessing knowledge of dental local anaesthesia

Knowledge Aspect	Familiarity Response	
	Familiar (% , N)	Not Familiar (% , N)
Maximum dose calculation	70% (297/422)	30% (125/422)
Aspiration step	84% (355/422)	16% (67/422)
Scoop technique	65% (273/422)	35% (149/422)
Post-operative instructions	83% (351/422)	17% (71/422)
Components of a typical dental syringe	84% (356/422)	16% (66/422)
Ingredients of a typical anaesthetic solution	83% (350/422)	17% (72/422)
Local anaesthesia contraindications	88% (370/422)	12% (52/422)
Reversal local anaesthesia	45% (192/422)	55% (230/422)

Different aspects of the practice of local anaesthesia were addressed, including the tendency of using topical anaesthesia and local anaesthesia, patterns of utilizing different techniques to provide local anaesthesia, variation in administering different local anaesthetic amounts, time spent administering anaesthetic solutions, difficulty and effectiveness of local anaesthesia, safety practices, and management of local anaesthesia's local and systemic complications. The subjects' response to the tendency of using topical anaesthesia and local anaesthesia in different specialties showed high use of topical and local anaesthesia in all specialties except in periodontics [Table 2]. Asked about the average number of cartridges of local anaesthesia administered to a healthy adult, participants responded as follows: 21% (90/422) less than one; 73% (310/422) one to two; 4% (17/422) three to four; and 1% (5/422) more than four [Figure 1]. The participants' response to the average time spent administering one complete cartridge of local anaesthesia was 19% (80/422) less than 10 seconds; 49% (205/422) 10 to 30 seconds; 28% (118/422) 30 to 60 seconds; and 5% (19/422) more than 60 seconds [Figure 2]. The subjects' response to the question about which local anaesthesia techniques they used revealed that the most commonly used technique for the maxilla was infiltration, and the most commonly used technique for the mandible

was nerve block [Table 3]. Regarding the difficulty of achieving successful local anaesthesia in the maxilla, the participants responded as follows: 5% (22/422) Extremely difficult; 6% (25/422) Very difficult; 11% (47/422) Moderately difficult; 22% (92/422) Slightly difficult; and 56% (236/422) Not difficult at all. The responses for the difficulty of anaesthesia in the mandible were: 5% (22/422) Extremely difficult; 9% (39/422) Very difficult; 29% (122/422) Moderately difficult; 38% (161/422) Slightly difficult; and 18% (78/422) Not difficult at all. Participants responded to the question about the overall effectiveness of local anaesthesia as follows: 36% (150/422) Extremely effective; 46% (194/422) Very effective; 10% (42/422) Moderately effective; 6% (26/422) Slightly effective; and 2% (10/422) Not effective at all [Figure 3]. The subjects' response to questions about safety practices showed high safety practices except in the maximum dose calculation [Table 4]. Participants responded to the presence or absence of personally encountered "Local" complications due to local anaesthesia question as 84% (354/422) present and 16% (68/422) absent. In regard to "Local" complications due to local anaesthesia, they were prevalent as follows: 28% Failure to obtain anaesthesia; 27% Pain on injection; 16% Needlestick injury; 4% Hematoma; 4% Edema; 3% Burning on injection; 3% Paraesthesia; 3% Infection; 3% Needle breakage; 3% Facial nerve

paralysis; 2% Trismus; 2% Postoperative intraoral lesions; 2% Sloughing of tissue; and lastly 1% Visual disturbance [Figure 4]. The participants' responses to the question regarding their confidence in managing "Local" complications from local anaesthesia were as follows: 14% (60/422) Extremely confident; 29% (124/422) Very confident; 36% (154/422) Moderately confident; 18% (74/422) Slightly confident; and 2% (10/422) Not confident at all. Participants responded to the question about the presence or absence of personally encountered "Systemic" complications from local anaesthesia as follows: 64% (270/422) present and 36% (152/422) absent. In relevance to "Systemic"

complications due to local anaesthesia, they were prevalent as follows: 27% Dizziness; 13% Syncope; 12% Anaphylaxis; 9% Hyperventilation; 7% Overdose toxicity; 7% Drug interaction; 7% Nervous system complications; 6% Palpitations; 5% Other cardiac complications; 5% Other respiratory complications; and lastly, 2% idiosyncrasy [Figure 5]. The participants' answers regarding their confidence in managing "Systemic" complications resulted from local anaesthesia were as follows: 10% (41/422) Extremely confident; 21% (88/422) Very confident; 31% (131/422) Moderately confident; 28% (118/422) Slightly confident; and 10% (44/422) Not confident at all [Figure 6].

[Table 2]: Addressing the practice of dental local anaesthesia in different specialities

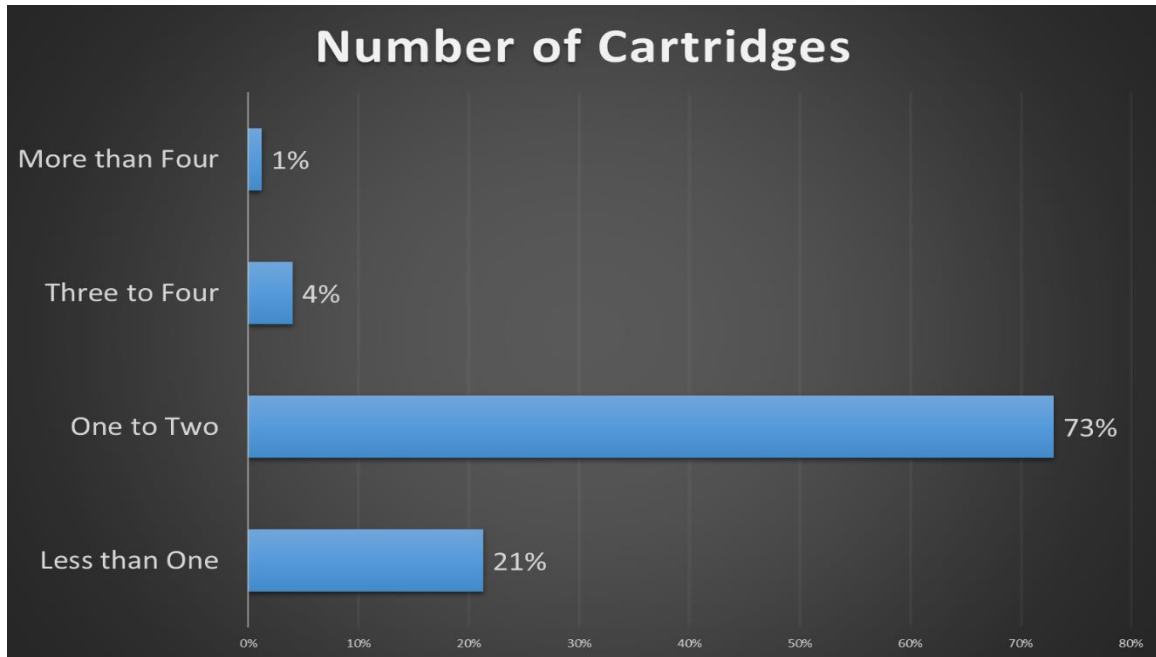
Practice of Topical and Local Anaesthesia in Different Specialties	Practice Response				
	Always	Very often	Sometimes	Rarely	Never
Topical Anaesthesia	80% (336/422)	13% (55/422)	4% (21/422)	2% (8/422)	1% (2/422)
Local Anaesthesia in Periodontics	13% (53/422)	9% (40/422)	13% (55/422)	29% (122/422)	36% (152/422)
Local Anaesthesia in Restoratives	61% (258/422)	29% (123/422)	5% (21/422)	4% (15/422)	1% (5/422)
Local Anaesthesia in Prosthodontics	30% (125/422)	29% (123/422)	30% (125/422)	9% (40/422)	2% (9/422)
Local Anaesthesia in Endodontics	87% (369/422)	8% (34/422)	4% (15/422)	1% (3/422)	0% (1/422)
Local Anaesthesia in Surgery	92% (388/422)	6% (27/422)	1% (5/422)	0% (1/422)	0% (1/422)

[Table 3]: Evaluating different dental local anaesthesia administration techniques

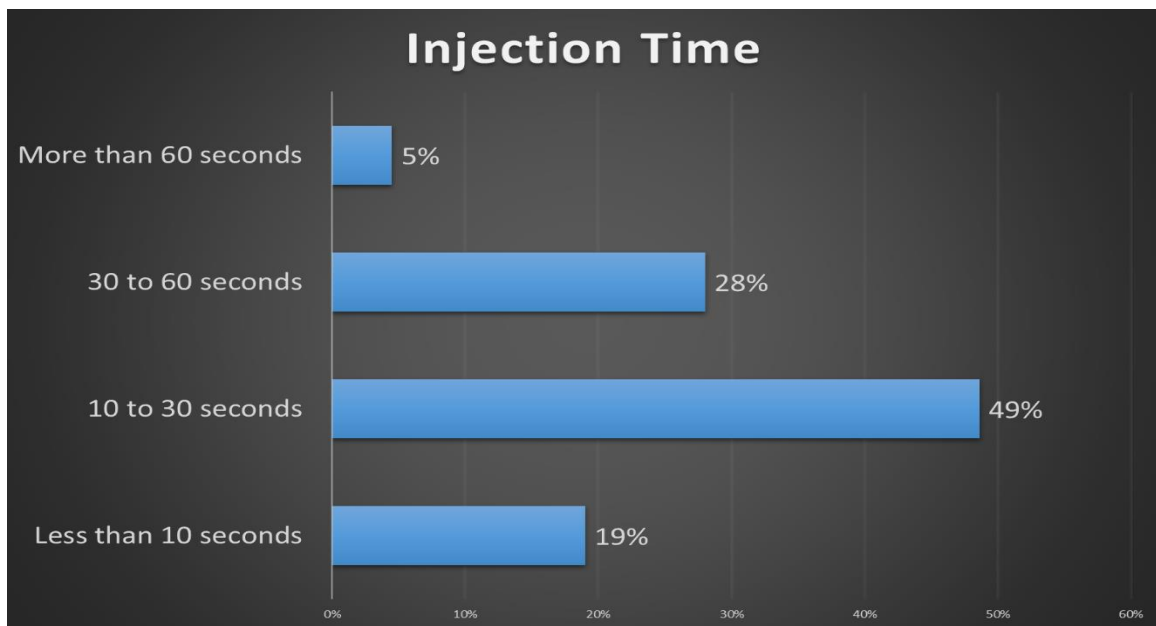
Practice of Different Local Anaesthesia Technique in Maxilla and Mandible		Practice Response				
		Always	Very often	Sometimes	Rarely	Never
Maxilla	Infiltration	80% (339/422)	12% (52/422)	6% (25/422)	1% (5/422)	0% (1/422)
	PDL Injection	9% (38/422)	17% (71/422)	35% (146/422)	28% (117/422)	12% (50/422)
	Nerve Block	12% (52/422)	11% (46/422)	17% (70/422)	16% (69/422)	44% (185/422)
Mandible	Infiltration	16% (68/422)	30% (126/422)	34% (145/422)	14% (59/422)	16% (24/422)
	PDL Injection	8% (32/422)	19% (82/422)	37% (158/422)	24% (103/422)	11% (47/422)
	Nerve Block	63% (264/422)	25% (105/422)	8% (35/422)	3% (11/422)	2% (7/422)

[Table 4]: Assessing safety practices of dental local anaesthesia

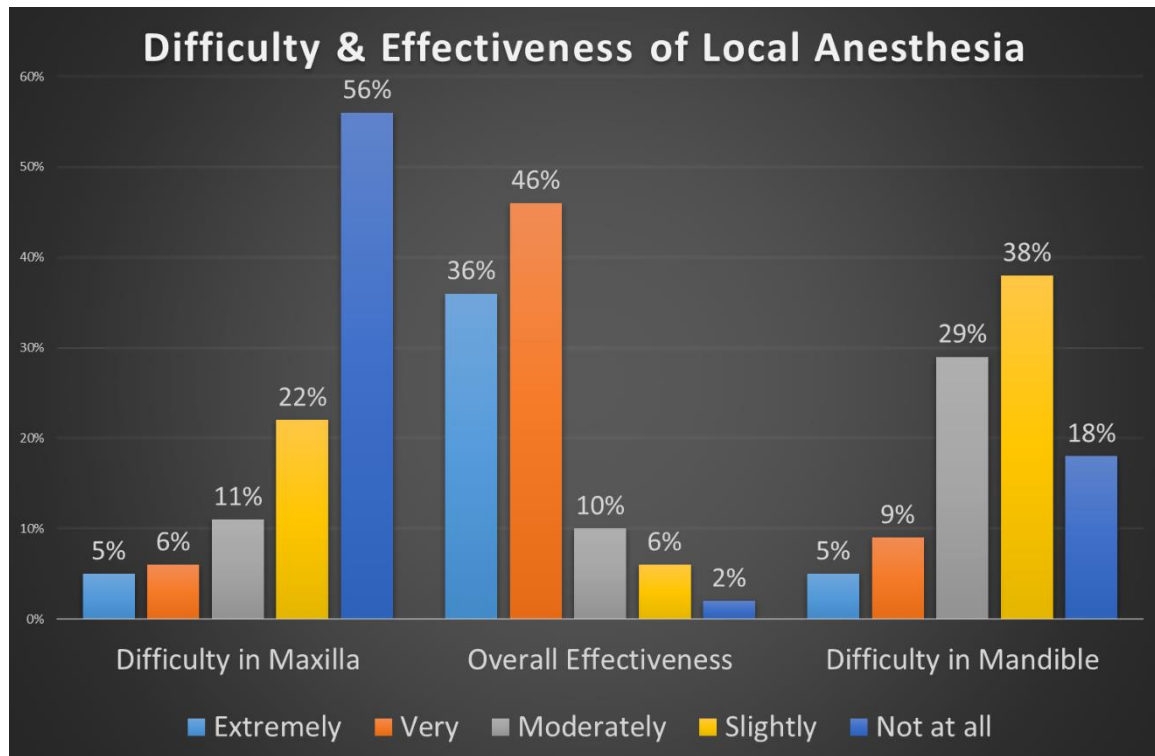
Safety Practice	Practice Response				
	Always	Very often	Sometimes	Rarely	Never
Maximum dose calculation	11% (45/422)	13% (53/422)	35% (147/422)	27% (112/422)	15% (65/422)
Aspiration	36% (153/422)	28% (118/422)	21% (88/422)	10% (41/422)	5% (22/422)
Scoop technique	38% (159/422)	16% (69/422)	16% (66/422)	8% (32/422)	23% (96/422)
Post-operative instructions	37% (155/422)	20% (86/422)	27% (112/422)	9% (40/422)	7% (29/422)



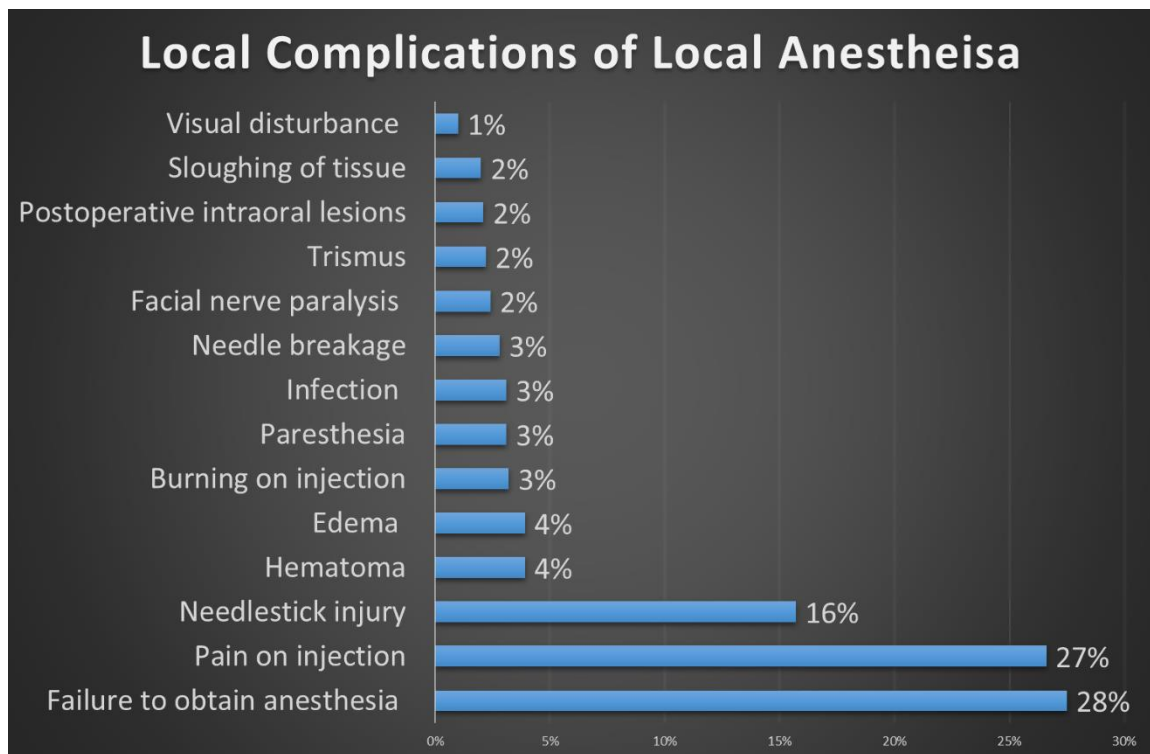
[Figure 1]: Average number of cartridges of local anaesthesia administered to a healthy adult



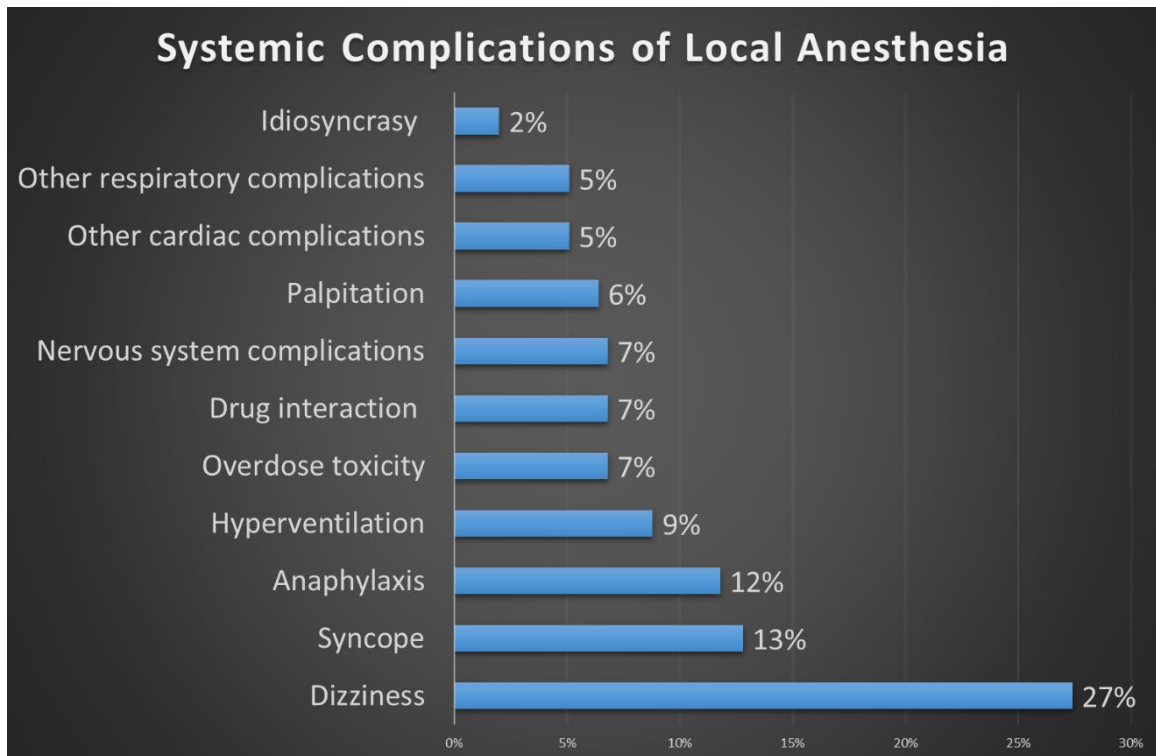
[Figure 2]: Time required to administer one complete cartridge of local anaesthesia



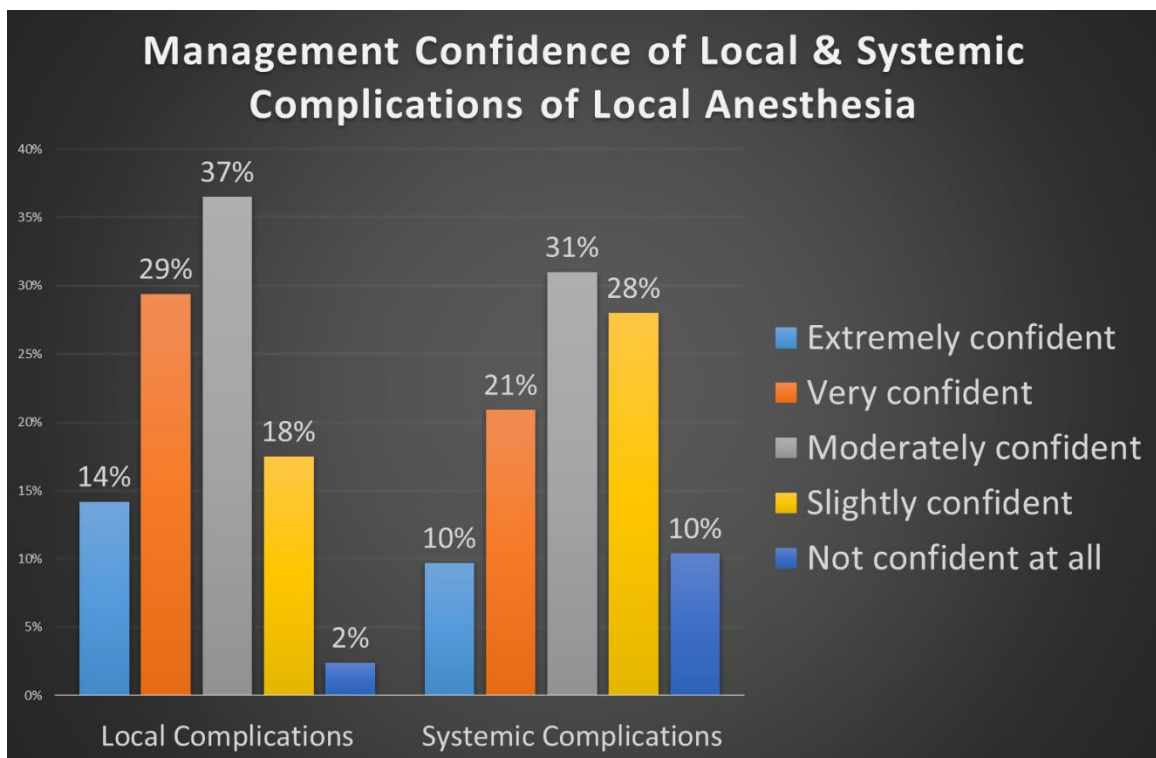
**[Figure 3]:** Effectiveness and difficulties of local anaesthesia in maxilla and mandible



**[Figure 4]:** Prevalence of different local complications resulted from local anaesthesia



[Figure 5] Prevalence of different systemic complications resulted from local anaesthesia



[Figure 6]: Confidence in managing local and systemic complications of local anaesthesia

Concerning correlation, multiple correlations were statistically significant regarding gender and years. Regarding the significant correlations with gender, females were more familiar with the concept of “reversal of local anaesthesia” (P value: 0.001), used local anaesthesia with prosthodontics more often (P value: 0.003), used the infiltration technique in the mandible more frequently (P value: 0.000), and spent less time injecting local anaesthesia than males (P value: 0.002). In regard to the significant correlations with years, subjects with a higher educational level “more years” showed an increase in the number of cartridges used (P value: 0.001), more use of local anaesthesia by infiltration in the maxilla (P value: 0.043), increased difficulty of achieving successful local anaesthesia in the mandible (P value: 0.036), less familiarity with the aspiration step (P value: 0.034), less practice of aspiration step (P value: 0.009), less practice of the scoop technique (P value: 0.035), less practice of giving post-operative instructions (P value: 0.010), and less use of local anaesthesia with restorative dentistry (P value: 0.004).

#### DISCUSSION:

Lee HS *et al.* reported that topical anaesthetics alter pain thresholds by controlling pain sensations through a blockade of signals that are transmitted from the peripheral sensory nerve fibers. However, they are only effective in blocking the pain stimuli in the superficial layer of the mucosa. (13) In this study, 80% of the participants always use topical anaesthesia. De St. Georges J *et al.* concluded that local anaesthetics need to be deposited as close to the nerve as possible so that optimal diffusion of the drug may occur, providing profound anaesthesia and pain-free dental experience. The importance of this is demonstrated by the fact that when patients are asked to list the most important factors when selecting a dentist, they said that the most important factor was a dentist who does not hurt. (14) In our study, subjects showed high use of local anaesthesia, especially for surgery, endodontics, restoratives, and prosthodontics. Kothari D *et al.* suggested that the most commonly used dental cartridge contains 1.8 mL of (2% lignocaine) local anaesthetic solution. In this cartridge, the concentration of epinephrine varies in concentration from 1:200,000 (5 µg/mL), 1:100,000 (10 µg/mL) to as high as 1:50,000 (20 µg/mL). (15) In the present study, 73% of participants used one to two cartridges to administer local anaesthesia for a healthy adult. Regarding the dental local anaesthesia injecting time and speed, De Souza Melo MR *et al.* reported that the pain associated with the IANB injection over 60 seconds was not clinically different from that of the injection over 100 seconds. The 60-second injection for the IANB may save a few seconds for the dentist without increasing the discomfort of the injection. (16) In this study, 49% of subjects spent 10 to 30

seconds to inject one complete cartridge of local anaesthesia. Due to the differences in the bone structure and components between the upper and lower jaw, different techniques are utilized for administering local anaesthesia to the maxilla or mandible. For example, Meechan JG *et al.* concluded that infiltration anaesthesia is the technique of choice in the upper jaw. It provides pulpal anaesthesia by diffusion into the cancellous bone via the thin cortical plate of the maxillary alveolus. The thicker cortical plate of the mandible is considered to be a barrier to such diffusion in the lower jaw. (17) In the current study, the most common technique for the maxilla was infiltration: 80% and the most common technique in the mandible was nerve block: 63%. Chandrasekaran B *et al.* investigated the difficulties of dental local anaesthesia among dental students and suggested that the results illustrate that only 39.7% of the operators could make the patient comfortable during the procedure. But 57.1% of the students neither agreed nor disagreed with this statement. 42.9% had difficulty in determining the insertion point, though 33.3% of the students agreed that their hands didn't shiver while giving the injection. A majority of the operators (42.9%) felt that they needed supervision in the forthcoming injection procedures. (18) In our study, 56% of participants had no difficulty achieving successful local anaesthesia in the maxilla and 38% had slight difficulty achieving successful local anaesthesia in the mandible. Santos-Paul MA *et al.* reported that local anaesthesia with or without epinephrine is considered to be the most effective method to eliminate or reduce pain for oral surgery. (19) In the current study, 46% of subjects found local anaesthesia to be very effective. In relevance to the maximum dose calculation, Kothari D *et al.* concluded that “the maximum dose of LA with epinephrine is 7 mg/kg and the concentration of LA used is 2% (20 mg/mL); thus the maximum volume of LA, which can be safely used is 0.35 mL/kg. In an average 60 kg adult, the maximum volume of LA that can be used is 21 mL (0.35 mL/kg × 60 kg) or 11 cartridges. The 21 mL volume of LA (1:200,000) preparation will deliver 105 µg of epinephrine, the 21 mL volume of LA (1:100,000) preparation will deliver 210 µg of epinephrine, and the (1:50,000) preparation of LA will deliver 420 µg of epinephrine, whereas the maximum recommended dose of epinephrine per appointment in a dental patient is only 40 µg”. (15) In this study, 70% of participants were familiar with the maximum dose calculation equation, and most (35%) sometimes practiced it. Meechan JG *et al.* suggested that when injecting into a blood vessel (for example during intravenous sedation), it is essential to aspirate blood into the syringe before the drug administration to ensure that the tip of the needle is lying within a vein. By the same token, when the injection is intended to be extravascular, it would appear to be



wise to ensure that no blood is aspirated into the syringe before drug delivery. This procedure is employed routinely by medical and nursing staff but is not universally accepted by dentists before the administration of dental local anaesthetics. (17) In addition, Zenouz AT *et al.* reported that accidental injection into the vessels might occur in all intra-oral injection techniques; however, when injecting into a highly vascular area, such as the pterygomandibular space during IANB, the dentist always faces the increased risk of an intravascular injection, vascular damage, and haemorrhage with hematoma formation. As reported, "15.3% of inferior alveolar nerve block injections were aspiration positive. Intravascular needle entrance was seen in 14.2% of cases using direct and 23.3% of cases using indirect block injection techniques". (20) In our study, 84% of subjects were familiar with the aspiration step before local anaesthesia administration, and most (36%) always practiced it. Froom P *et al.* concluded that the scooping technique method is highly effective in reducing the risk of needle-stick injuries in dental students. It is performed by leaving the needle cap on the surface and guiding the tip of the needle tip into it using only one hand. Then, lifting the needle and syringe vertically and, once the tip is covered, the other hand is used to fix the cap into place. (21) In current the study, 65% of participants were familiar with the scoop technique for needle recap, and most (38%) always practiced it. Becker DE *et al.* suggested that the post-operative instructions following local anaesthesia include emphasizing not to traumatize the anaesthetized tissue while soft tissue is numb, reporting any complications if present, and informing the patient about the expected wear-off time (duration) of the local anaesthetic effect. For instance, the 1.8 mL of (2% lignocaine) local anaesthetic solution duration of action is 90 to 200 minutes. (7) In this study, 83% of subjects were familiar with the post-operative instructions related to local anaesthesia, and most (37%) always provided them. About the main components of a typical dental syringe, Kwak EJ *et al.* discussed the importance and function of different dental syringe parts and concluded the main components to be barrel, plunger, needle, and cap. (22). In our study, 84% of participants were familiar with the different components of the typical dental syringe. Furthermore, Ketabi M *et al.* concluded the typical contents or ingredients of the local anaesthetic solution to be the local anaesthetic agent, vasoconstrictor agent, preservative agent, and isotonic solution. (23) In the current study, 83% of subjects were familiar with the ingredients "content or composition" of the local anaesthetic solution. Moreover, Pagliughi G *et al.* claimed that local anaesthesia agents are extremely handy and constitute a valuable aid in many situations; still, possible contraindications must be assessed. (24) In the current study, 88% of participants were familiar

with the contraindications of local anaesthesia. Concerning local and systemic complications resulting from dental local anaesthesia, Akifuddin S *et al.* reported the cumulative percentage of dental local anaesthesia complications to be 8%. Failure of anaesthesia (23%) was the most common local complication. Syncope (67%) was the most common systemic complication. (25) In this study, the most common local complications resulting from local anaesthesia were a failure to obtain anaesthesia (28%) followed by pain on injection (27%). The most common systemic complications resulting from local anaesthesia were dizziness (27%) followed by syncope (13%). About the local anaesthesia reversal concept, Saxena P *et al.* concluded that "In May 2009, The FDA approved OraVerse (phentolamine mesylate; Novalar Pharmaceuticals Inc, San Diego, CA, USA) for the reversal of soft tissue anaesthesia and the associated functional deficits resulting from a local dental anaesthetic. Phentolamine seems to be safe and effective in reducing soft tissue local anaesthetic recovery time in adults and children as young as 6 years.". (9) In our study, 55% of subjects were not familiar with the concept of "reversal of local anaesthesia."

To conclude, regarding knowledge of local anaesthesia, findings suggest a noticeable high level in different knowledge aspects except in familiarity with the concept of local anaesthesia reversal. Regarding the practice of local anaesthesia, findings suggest high use of topical and local anaesthesia in all specialties except in periodontics. The most common number of used cartridges was between one to two cartridges, and the most common injection time was between 10 to 30 seconds. Local anaesthesia safety practices were shown to be high except in the maximum dose calculation. The most commonly used anaesthesia technique in the maxilla was infiltration, and the most commonly used anaesthesia technique in the mandible was nerve block. Local anaesthesia in the maxilla was not difficult at all; local anaesthesia in the mandible was slightly difficult, and both were very effective. The most common local complications were a failure to obtain anaesthesia followed by pain on injection, and the most common systemic complications were dizziness followed by syncope. Moderate confidence was the most common level of confidence in managing local anaesthesia's local and systemic complications. The limitations of this study were mainly related to the lack of previous research studies on the topic. The future scope of the present study suggests the need for high-quality studies regarding the topic of dental local anaesthesia as it showed a lack of data in the literature, especially in Saudi Arabia.

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