

## *Endodontic treatment during pregnancy: case series and literature review*

### *Tratamento endodôntico na gestação: série de casos e revisão da literatura*

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#### **ABSTRACT**

The aim of this paper is to provide a scientific basis for conducting safe root canal treatment in pregnant women, illustrating with case reports treated in the extension project Maternal-Child Dental Care at the Federal University of Pelotas. The scientific bases address the main doubts of professionals when performing prenatal dental care: use of radiographic examination, local anesthetics, prescription of medications, among other essential factors in the care of pregnant women. The assisted pregnant women sought care with dental pain. In two cases symptomatic irreversible pulpitis was diagnosed, while a third was experiencing acute apical periodontitis. Endodontic procedures were performed under controlled and standardized conditions. The root canals were prepared in a single session, using mechanical instrumentation with reciprocating kinematics (Wave One® Gold Primary - Dentsply Sirona), and the root canal length was determined by an electronic apex locator FinePex (Schuster). Root canal filling was performed by the single cone technique with Wave One® gutta-percha points. After endodontic treatment, coronal sealing was performed with composite resin A2 Z350 XT (3M ESPE). The care related to the gestational condition is highlighted, and the patients remain under monitoring. It is concluded that the use of apical locators and mechanical instrumentation, using reciprocating files associated with the single cone obturation technique with a standardized cone for each system, represents advances for the accomplishment of endodontic treatment in pregnant patients due to the shorter clinical time and greater comfort of the procedure.

**Indexing terms:** Endodontics. Pregnancy. Root canal preparation.

#### **RESUMO**

*O objetivo deste trabalho é fornecer embasamento científico para condução do tratamento endodôntico em gestantes através de uma revisão de literatura e série de casos clínicos conduzidos em sessão única no projeto de extensão Atenção Odontológica Materno-*

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*infantil da Faculdade de Odontologia da Universidade Federal de Pelotas. As bases científicas abordam as principais dúvidas do profissional na condução do pré-natal odontológico: uso do exame radiográfico, anestésico local, prescrição de medicamentos, entre outros fatores essenciais no atendimento da gestante. As gestantes assistidas procuraram atendimento apresentando dor de origem dentária. Em dois casos foi diagnosticado pulpíte irreversível sintomática, enquanto um terceiro se tratava de periodontite apical aguda. Os procedimentos endodônticos foram realizados sob condições controladas e padronizadas, sob supervisão de um professor de Endodontia. O preparo dos canais radiculares foi realizado em sessão única, através de instrumentação mecanizada de cinemática recíprocante (Wave One® Gold Primary (Dentsply Sirona), sendo o comprimento dos canais determinado por meio de localizador foraminais FinePex (Schuster). A obturação dos canais foi realizada pela técnica do cone único com cones do sistema Wave One®. Após o tratamento endodôntico foi realizada blindagem coronária com resina composta cor A2 Z350 XT (3M ESPE). Os cuidados relacionados à condição gestacional estão destacados, sendo que as pacientes permanecem em acompanhamento no projeto. Conclui-se que o uso de localizadores foraminais e da instrumentação mecanizada, utilizando limas recíprocantes associadas à técnica de obturação com cone único padronizado para cada sistema representam avanços para a realização do tratamento endodôntico em pacientes gestantes devido ao menor tempo clínico e maior conforto do procedimento.*

**Termos de indexação:** Endodontia. Gravidez. Tratamento de canal.

## INTRODUCTION

Prenatal oral health plays an important role in the general health and well-being of pregnant women, and is also fundamental for the health and well-being of their newborn children [1-2]. In the oral cavity, hormonal variations typical of pregnancy have been related to changes in periodontal tissues [3-5], besides other oral changes as tooth mobility and salivary changes [5-6]. Also, several gestational factors may predispose to a higher occurrence of dental caries, including increased acidity in the oral cavity, poor oral hygiene, cariogenic diet, low salivary pH, vomiting [4-7] and increased frequency of food ingestion due to the decreased physiological capacity of the stomach [1].

It has been shown that pregnant women have a high frequency of dental pain, especially after the first trimester of pregnancy [8], and that hormonal changes may increase the inflammatory condition or predispose to painful pulp symptoms in the gestational period [9]. Alike the periodontium, the dental pulp is a loose connective tissue, yet enclosed by rigid walls of mineralized dentin [10]. After a pathogenic aggressor crosses the threshold of physiological tolerance of the pulp, this tissue will respond by an inflammatory reaction to eliminate the aggressive agents [11].

As a consequence of the inflammatory process, there is pain, yielding a stressful situation with release of catecholamines by the adrenal glands, which may consequently trigger, in the maternal circulation, tachycardia, peripheral vasoconstriction and reduced placental blood flow [12]. However, if the aggressor is not eliminated, which may occur during evolution of the carious process, this immune inflammation eventually leads to irreversible destruction of the pulp [11]. The infection is also harmful to the mother and the fetus [12], and the presence of periapical lesions may be associated with preeclampsia [2].

Although invasive dental treatment is more recommended after the second trimester of pregnancy, pain of dental origin should be eliminated regardless of the trimester of pregnancy [13]. Due to persistent taboos and myths, it is not uncommon to perform only the procedure to solve the pain [5]. These myths, both of pregnant woman and of health professionals themselves, are the greatest barrier to dental treatment during pregnancy [14]. The most common lack of knowledge that lead to postponement of care include exposure to X-ray, drug prescription and the use of local anesthetics [14]. Even for those aware of the safety of endodontic treatment in pregnant women, there are gaps in knowledge regarding proper positioning in the chair, the treatment time and the safety of using irrigators [15].

The physical condition of the pregnant woman can preclude the conventional accomplishment of endodontic treatment. However, the use of mechanical instrumentation in root canal preparation [16], combined to the use of an electronic apex locator, reducing the radiation dose [17], and simplified obturation techniques using a single cone favor the accomplishment of endodontic treatment in a shorter clinical time [16,17], improving the working conditions for both professional and patient [16]. Thus, the objective of this paper is to provide scientific basis to perform endodontic treatment in pregnant women, illustrated with reports of a series of clinical cases conducted in a single session in the extension project Maternal-Child Dental Care (AOMI) of the School of Dentistry of the Federal University of Pelotas (UFPel).

## Scientific bases

Before the case reports, an initial approach to the scientific bases that underlie dental treatment during pregnancy is fundamental. In the dental care of a pregnant woman, it is important to understand that we are working in an important period in the life of a woman who will be a mother. In this condition, we work within the first thousand days of the child, performing dental prenatal care in which the proposal is to demystify dentistry during pregnancy, minimizing existing taboos, beliefs and myths; to perform adequacy of the maternal oral environment, providing reduction of mutans Streptococci to delay contamination; to promote the adequacy of maternal habits, both in oral hygiene and diet; to favor the baby's general health, interfering with toothaches and the risk of preterm and/or low birth weight [18].

Pregnant women are considered patients with special needs, i.e. they are individuals who present a condition, simple or complex, momentary, of biological and physical etiology that requires a special, multi-professional approach and a specific protocol [1]. Like any other system, the oral cavity exhibits several changes during pregnancy and thus requires attention from dental professionals [5]. Initially, it is important to understand that, during pregnancy, maternal circulating immune cells undergo changes in count, phenotypes, functions and ability to produce soluble factors, such as cytokines. The ultimate goal is to establish and maintain a successful pregnancy, which involves a state of selective immune tolerance, immunosuppression and immunomodulation [19]. The functions of T lymphocytes and NK cells (Natural Killer) reduce the secretion of type 1 cytokines and protect the fetus from destruction by maternal immune responses, leaving women at greater vulnerability to diseases [19].

In any dental care, correct diagnosis is essential for a safer planning. In the process, besides thorough clinical examination (complete anamnesis on pregnancy, oral habits and physical oral examination), complementary examinations are often necessary, including dental radiographic examination. The risks associated with dental radiography are quite low. The biological effects of radiation can be somatic or genetic [20]. The risk of inducing fatal cancer or severe hereditary health problems was theoretically estimated to be approximately one in 10 million for each periapical or interproximal intraoral film. Extraoral panoramic films have a suggested risk of one in one million [20]. It is important to highlight that the radiation dose acquired by the baby from the mother's dental X-ray is only 0.01 mSv (miliSievert) [20]. In addition, no increase in congenital anomalies or delayed intrauterine growth has been reported for X-ray exposure during pregnancy below 5-10 cGy (centiGray) [3]. The most sensitive time for the effects of radiation to the fetus is between days 32 and 37 (approximately 4½-5½ weeks) of pregnancy, i.e. during organogenesis [20]. Thus, during dental prenatal care, when achieving a radiography, ultra-fast films should be used, as well as lead protection (apron and collar) [3,21]; film holder [21]; if possible, perform digital radiography; achieve only the number of radiographs that are strictly necessary [3,21]; and, during endodontic treatment, prefer to use an electronic apex locator [7].

Another important situation is the sensory control of pain during dental procedures. The most common method is the use of local anesthetics, and its use in pregnant women raises several doubts. Can I anesthetize pregnant women? Does the anesthetics reach the baby? Which local anesthetic can I use? Can I use vasoconstrictors? What dose can I use? And is topical anesthetics indicated? The first information is that there is no data indicating that exposure to dental treatments and the use of local anesthetics during pregnancy is associated with an increased risk of abnormalities in the baby [22]. However, during anesthesia in the pregnant woman, the free local anesthetics in the maternal circulation crosses the placental barrier and can reach the fetus minutes after injection, constituting a direct transfer [21]. The main function of placenta is to transfer nutrients and oxygen from the mother to the fetus and it also provides a link between the circulations of two distinct individuals, but it also acts as a barrier to protect the fetus from xenobiotics from the mother's blood. However, the impression that the placenta constitutes an impenetrable obstacle to most drugs is not true [23]. In addition, it can also reach the baby indirectly, through the mother, depressing the cardiovascular system and decreasing the uterine tone. However, this only occurs at extremely high plasma levels [13].

When choosing the best anesthetics, the percentage of protein binding, coefficient of liposolubility and the classification by the Food and Drug Administration (FDA) must be observed. Concerning protein binding, the higher the rate, the longer the local anesthetic action tends to be, and its toxic effects tend to be more lasting. Only free compounds that do not bind to proteins are transferred to the fetus through the placenta [12]. Regarding liposolubility, the higher

the coefficient of the drug, the more easily it penetrates the cell and the more powerful it will be. Finally, animal studies evaluating the effect on the fetus are important, in which class B shows no risk to the fetus, while in class C the animal studies showed an adverse effect on the fetus, thus the professional must evaluate the risk/benefit of using the drug [12,13]. Vasoconstrictors decrease the toxicity of local anesthetics and increase the analgesic effects, and the use of catecholamines, especially adrenaline/epinephrine is more indicated. Epinephrine-induced vasoconstriction delays the absorption of local anesthetics by the mother, thus the local anesthetics is transferred to the fetus slowly, and its security margin is also increased [13]. However, high-dose epinephrine in the blood causes a decrease in uterine blood flow, but in general there does not appear to be any significant contraindication for the careful use of epinephrine in pregnant patients. The protein binding of local anesthetics is reduced in pregnant women with preeclampsia or eclampsia and a large amount of local anesthetics can be transferred to the fetus [13], thus it should be used with caution in pregnant women with hypertensive problems.

Thus, the most recommended anesthetic drug is 2% lidocaine, class B, 64% binding to plasma proteins and coefficient of liposolubility 4, with adrenaline 1:100,000, injecting slowly and using at most two tubes per session as a safety measure [21]. The maximum recommended dose is 7mg/kg with vasoconstrictor, but the use of a lower dose is justified due to the dilution of blood volume and decrease in protein binding during pregnancy [24]. Bupivacaine, despite having 95% protein binding, has coefficient of liposolubility 28 and is classified as C, because it inhibits the cardiac conduction and can lead to cardiac arrest. The caution recommendation (Category C) for bupivacaine mainly refers to data collected in teratogenicity studies in animals, but in case it is necessary, further reducing the dosage would be an option [24]. There is still doubt as to the use of topical anesthetics; both lidocaine (category B of FDA) and benzocaine (category C of FDA) are slowly absorbed by the cardiovascular system and are less likely to lead to intoxication reaction [21]. It is important to note that its use in small quantities, besides reducing the effect of needle puncture, acts on the emotional control of pain, favoring care as a whole.

In pregnancy, almost all drugs administered will enter the fetus circulation by passive diffusion to some degree. Also, some drugs are pumped through the placenta by several active transporters located on the fetus and mother [23]. In dental care for a toothache, the use of analgesics is indicated, and in some situations the use of antimicrobials is systemically compromised. There is a representative of FDA classification B for both situations. For systemic pain control, at any stage of pregnancy, for a short period (48 to 72 hours), acetaminophen 500 mg/750mg can be used at every 6 hours. It is not advisable to exceed more than four grams per day, due to the side effect of hepatotoxicity [24]. For the use of antimicrobials, indicated in cases of symptomatic tooth abscess with systemic involvement, with fever above 37.80C, the first choice is beta-lactam derivatives and, among them, amoxicillin, cephalosporin and as second choice clindamycin, which is contraindicated in pregnant women with hepatic alterations, or erythromycin stearate. Their use should not exceed 15 days, since it may lead to cholestasis of the newborn [21].

Regarding anti-inflammatory drugs, it is advisable not to indicate their use, although Ibuprofen is considered class B until the last trimester, when it switches to D, in which there is positive evidence of human fetal risk, associated with decreased amniotic fluid, premature closure of the heart valve and limited vaginal opening during delivery [24]. Thus, postoperatively, non-drug therapy with heat and cold contrast is chosen. But, when necessary, a good anamnesis should be performed adhering to the following principles for prescription: use the lowest effective dose for the shortest time; evaluate the risk/benefit binomial; contact the obstetrician [21]. The most critical period with rapid cell division and active organogenesis occurs between the second and eighth weeks post-conception [6]. It is important to emphasize that the use of drugs is not recommended in the first 13 weeks, i.e. in the first trimester [5], a period during which many women do not even know they are pregnant.

Finally, it is important to know other situations that interfere with dental care during pregnancy: the use of rubber dam and positioning in the chair (figure 1). During pregnancy, one of the respiratory changes aims to accommodate the increase in size of the developing fetus. The enlarged fetus pushes the diaphragm upward by 3 to 4 cm, increasing the intrathoracic pressure. Diaphragm displacement leads to a reduction of 15% to 20% in the residual functional capacity [6]. In addition, in the supine position, compression of the inferior vena cava and aorta by the uterus [5,6], especially

after the 20th week of pregnancy [13], can lead to the development of supine hypotensive syndrome, in which there is a decrease in cardiac output, resulting in hypotension, syncope and decreased utero-placental perfusion [6]. Thus, the ideal position of the pregnant woman in the dental chair is left lateral decubitus position with the right hip elevated by 15° [6] or, in slightly longer sessions, from time to time, turn to the left for a few minutes and also at procedure completion [21].

## CASE REPORT

Since 2000, the extension project Maternal-Child Dental Care (AOMI) of the School of Dentistry of UFPel has worked on mother-child dyads, working on the first thousand days of the child, that is, 270 days of pregnancy with 730 days of the first two years of life. Women attend AOMI when pregnant and receive dental care to improve and recover their oral health. Upon arrival, at any stage of pregnancy, an interview is performed, as well as examination of the oral cavity and planning that is designed and applied according to the needs of the pregnant woman, her physical and systemic condition, capacity of the project to receive and following the guidelines of scientific evidence summarized in table 1. Endodontic therapies are performed as an integral part of maternal oral health promotion, enabling the existence of a health multiplier effect. The project's motto is "*I will be able to care for my child's oral health if I know and am able to care for mine*", and the results have been evaluated in different studies, with approval by the institutional Review Board, IRB report n. 57/2013 of FO/UFPel.

**Table 1.** Summary of guidelines for dental procedures during pregnancy.

| Procedure              | Guidelines   |
|------------------------|--|
| Oral cavity hygiene    | Toothbrushing and topical use of 2 <sup>o</sup> chlorhexidine to minimize the transitional bacteremia.   |
| Radiography            | Achieve only the strictly necessary radiographs.<br>If possible, achieve digital radiography.<br>If conventional, use ultra-fast films, lead apron and collar, film holder [3,21].<br>In endodontic treatment, preferably use electronic apex locators [17].             |
| Local anesthetics      | Use 2% Lidocaine, class B according to the FDA, 64% of bonding to serum proteins and coefficient of liposolubility 4; use adrenaline as vasoconstrictor; inject slowly and use at most two anesthetic tubes for safety [21,24].  |
| Rubber dam isolation   | Release the nostrils after the 28 <sup>th</sup> week of pregnancy to facilitate breathing.<br>The increase in fetal size compresses the diaphragm and reduces the functional capacity in 15% to 20% [6].   |
| Chair positioning      | As comfortable for the pregnant woman as possible.<br>Prevent the supine hypotensive syndrome, raising the right hip in 15° (using a pillow) [6,21] or turn to the left from time to time and at completion of the procedure, to decompress the inferior vena cava [21]. |
| FDA Class B Medication | Analgesics: acetaminophen 500 mg/750mg at every 6 hours, for a short period (48 to 72h) [24].<br>Antimicrobial: the first choice are beta-lactam derivatives, if there is systemic involvement [21].   |

Note: FDA: Food and Drug Administration.

Following, three clinical cases are presented, recently conducted in patients C.A.L., C.P.R. and K.L.R., respectively with 35, 11 and 12 weeks of pregnancy, who attended the AOMI project with dental pain in the region of lower first molars. The diagnosis, performed by physical inspection and examination of periapical radiographic image, showed that, in one of the cases (C.A.L.), tooth 46 had apical periodontitis as shown in figure 2. In the other two cases, irreversible acute pulpitis was diagnosed in teeth 46 (C.P.R.) (figure 3A) and 36 (K.L.R.) (figure 3B). All patients had painful symptoms at the time of consultation. It is important to highlight that the patient K.L.R. had severe pain, being referred by a professional from the Basic Health Unit who preferred not to assist her.

In the three cases, the following protocol was used:

1. Before each dental appointment, a 2% chlorhexidine solution (MAQUIRA<sup>®</sup>) was used topically, passed on the mucosa using cotton balls, minimizing the unpleasant taste compared to mouthwash.

2. Then, local anesthesia was performed by blocking the inferior alveolar nerve, using 1.8 ml of 2% lidocaine with epinephrine 1:100.000 (Alphacaine 2%, Nova DFL®), followed by rubber dam isolation. Only for C.A.L. the dam was adapted to release the nostrils (figure 2) and favor breathing (35 weeks of pregnancy).

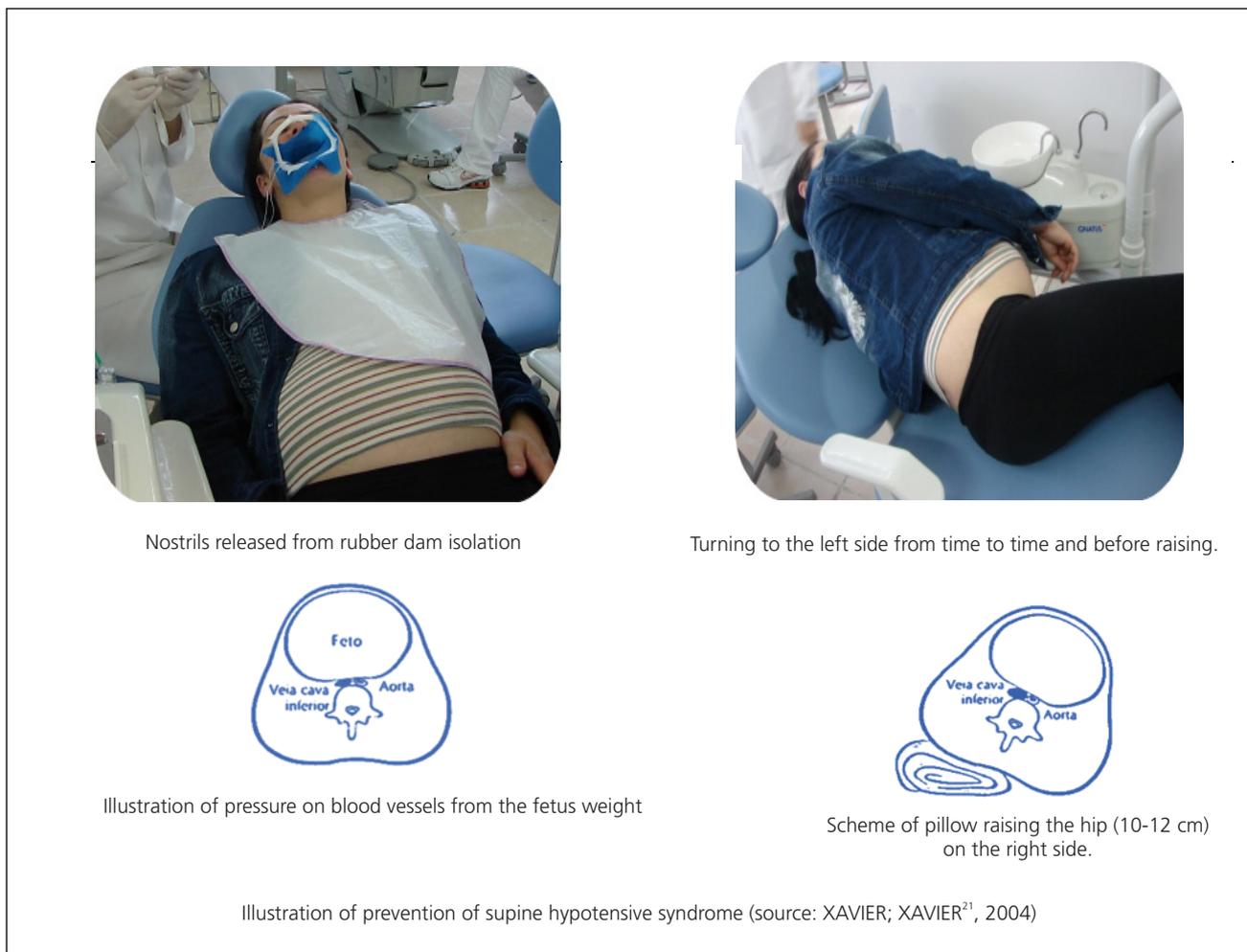
3. Coronal opening of the tooth was performed or completed using a round 1012 diamond bur (KG Sorensen®) and Endo Z drill (Dentsply Maillefer®).

4. After irrigation with 2.5% NaOCl and exploration of root canals with a manual file n. 15, the working length was determined using the FinePex electronic apex locator (Schuster®), established at 1 mm below the locator's 0 mark.

5. After achieving apical patency with a K file n. 15 (Dentsply Maillefer®), the reciprocating instrument was selected following the manufacturer's instructions. In all cases, the Wave One® Gold Primary 25.07 instrument (Dentsply Sirona®) was used on the VDW.SILVER® RECIPROC (VDW) endodontic engine.

In two cases (figures 2 and 3A) the irrigation protocol used 2.5% sodium hypochlorite throughout instrumentation, and final irrigation with 17% EDTA solution (Biodynamics®). For K.L.R., 2% chlorhexidine gel (Farmácia Drogal, Piracicaba, SP, Brazil) and saline were used as an auxiliary chemical solution.

6. Obturation was performed by the single cone technique, using the gutta percha cone of the Wave One® Gold system with the same diameter as the primary file. After radiographic fitting of the cone, obturation was performed with

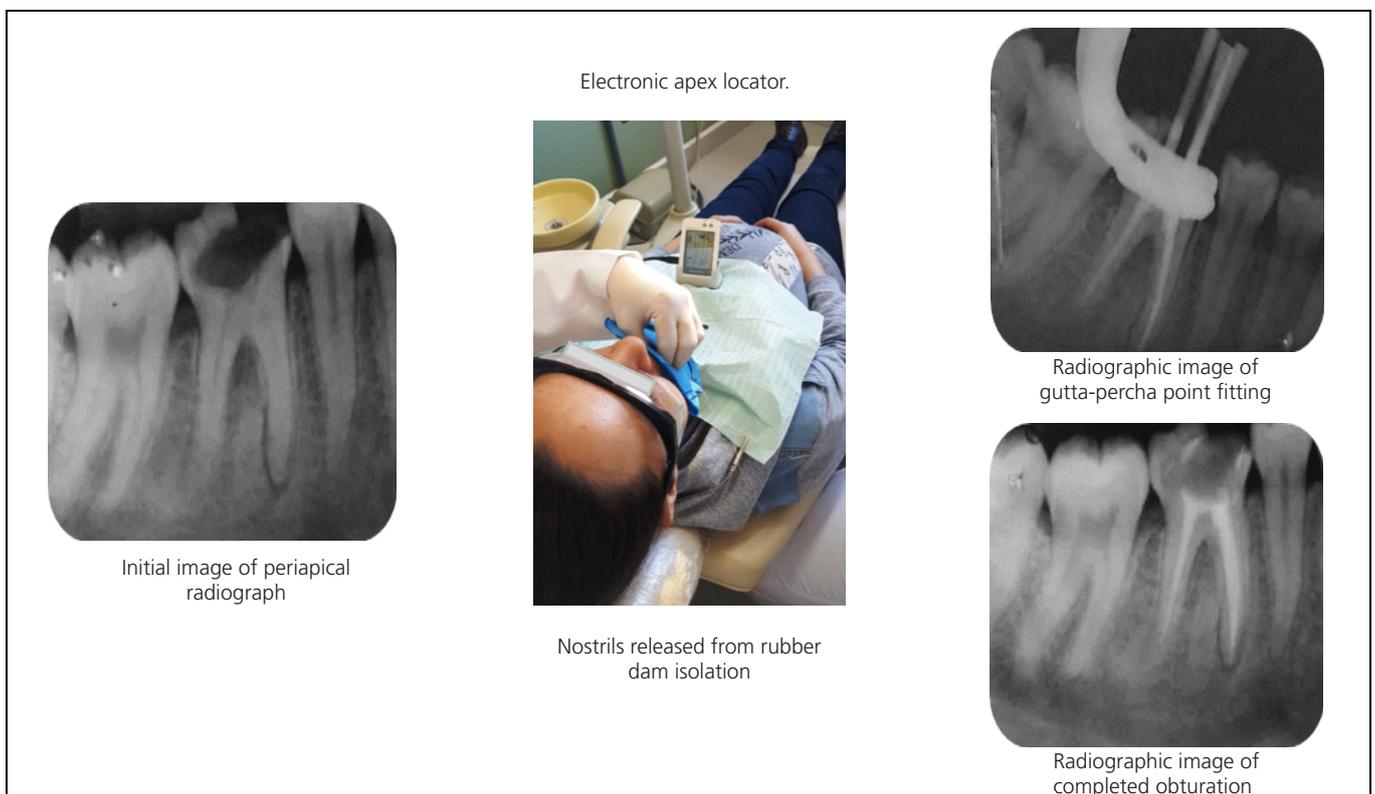


**Figure 1.** Image of care taken during the dental treatment of pregnant women.

Endofill obturation cement (Dentsply Sirona) and a provisional restoration was performed with zinc oxide and eugenol (cases 2 and 3) or glass ionomer cement (case 1) to avoid extending the time of clinical care. In the end, the pregnant women were positioned laterally to the left side for a few minutes, preventing supine hypotension when getting up from the chair. The 35-week pregnant woman was placed in this position, from time to time during the consultation.

7. Follow-up after seven days, when all patients reported absence of postoperative symptoms. In this consultation, the final periapical radiography was performed, as well as coronal sealing with composite resin shade A2 Z350 XT (3M ESPE) and tooth restoration with composite resin of the same brand, but with shade variation according to the case.

After delivery, the pregnant women assisted at the project have clinical and radiographic follow-up of endodontic treatments performed. The AOMI project monitors the mother-child dyads (a) until they reach 36 months of age, and the first follow-up occurs approximately when the baby is seven to eight months old, or at any time when needed.



**Figure 2.** Case report 1: C.A.L., aged 19 years, 35-week pregnant and with pain in tooth 46, with diagnosis of apical periodontitis.

## DISCUSSION

Pregnancy is a period of particular vulnerability concerning oral health. Among the oral problems, the greater presence of dental caries [4-7] may favor toothache [8] because it has been suggested that pulp inflammation may be exacerbated by gestational hormonal changes [9]. In addition, the prevalence of preeclampsia was significantly higher in pregnant women who had apical periodontitis, providing initial evidence that it can be a strong independent predictor for preeclampsia [2].

Although there is sufficient evidence that the lack of oral health care during pregnancy can have negative results for mothers and their newborns [1,6], there are still many taboos and myths about dental treatment in pregnancy of



**Figure 3.** Radiographic images of clinical cases of irreversible pulpitis.

both professionals and patients [13,14]. These fears have no reason to exist [5], and pregnant women must be assisted [1], especially when there are urgent dental needs (pulpitis, abscesses, etc.) [12]. In these cases, treatment cannot be postponed, regardless of the gestational period, since the consequences of pain and infection can be much more harmful to the mother and fetus than those resulting from dental treatment [12]. Thus, offering the necessary dental treatment, managing oral infection and pain control is an essential function of dental professionals to help patients maintain their general health during pregnancy.

The previous use of chlorhexidine in the oral cavity is an approach that is part of the protocol for the care of pregnant women in the AOMI project, together with measurement of blood pressure. Even though pregnant patients are generally not immunocompromised, there is a decrease in immunity and in the activity of NK cells [3]. Immunosuppression would be one of the indications for prophylaxis of postoperative infection, but besides the tendency to avoid the prophylactic use of antibiotics associated with dental procedures [26], the condition of the pregnant woman is transient [1]. However, handling the oral cavity without any care could lead to transient bacteremia. The endodontic procedure per se would cause a low risk of bacteremia, 31% in case of extra canal instrumentation and 29.4% with rubber dam placement, but if anesthesia is performed with intraligamentary injection, the possibility increases to of almost 100% [25].

In this context, infections can be prevented by non-pharmacological measures, such as maintaining correct oral hygiene and using chlorhexidine mouthwash before the usual dental procedures [25]. Chlorhexidine is a topical antimicrobial, classified as category B in pregnancy by the FDA [3-5]. Thus, even without consensus on its need, the use of 2% chlorhexidine topical antimicrobial does not cause any problem to the pregnant woman and promotes the reduction of oral bacteria.

There were two cases of irreversible acute pulpitis, a pulp condition that indicates advanced stage of inflammation with presence of acute, spontaneous, intense, pulsatile pain [26]. For endodontic treatment, control of intraoperative pain is essential and lidocaine was the local anesthetics used in these and other dental treatments performed in pregnant women in the AOMI project, since it is category B of the FDA and has almost no negative effect on the mother and fetus [24]. However, its use must be associated with a vasoconstrictor, injected slowly and in a reduced dose [13], at most two tubes [21]. In addition, negative aspiration should be monitored to ensure that local anesthetics is not injected into the blood vessel [13].

One of the important steps in the endodontic technique is the accurate determination of the working length. Currently, the use of electronic apex locators not only improves clinical time, but also reduces radiation [17]. The reliability of its accuracy is superior to radiographies during odontometry [27], promoting a reliable determination for the treatment in a fast manner. Reduction in the number of radiographs is an important factor, since one of the greatest fears of both professional and pregnant woman is the X-ray exposure [14,15]. In the reported cases, the patients underwent periapical radiographs in an appropriate and safe manner at all moments. It should be mentioned that, even when conducting the recommended care for patients in general, during pregnancy it is also important to only achieve the necessary radiographs. Although inadvertent exposure in pregnancy does not increase the natural risk of congenital anomalies, it can create a considerable state of maternal anxiety [28] which can somehow affect the well-being of mother and baby.

Regarding the irrigating solution, 2.5% sodium hypochlorite is the first choice in the AOMI project, since it has an antimicrobial action and acts as a tissue solvent [29]. Although sodium hypochlorite is an effective antibacterial agent, it can be highly irritating when in contact with vital tissue. Most reported complications occurred due to incorrect determination of endodontic working length, iatrogenic enlargement of the apical foramen, lateral perforation [30]. Conversely, chlorhexidine has been widely used as an irrigating solution due to specific properties that enable its use, such as substantivity, antimicrobial effectiveness and low toxicity [29]. Due to its low toxicity, 2% chlorhexidine has become an excellent possibility of irrigating solution in endodontic treatment performed during pregnancy. In addition, in a randomized clinical study, no significant difference was observed for clinical antibacterial efficacy in root canal preparation with rotary instruments using 2.5% sodium hypochlorite or 2% chlorhexidine as the main irrigating agent [31].

In the reported cases, the root canals were instrumented by the reciprocating instrumentation technique and obturated by the single cone technique. When evaluating 84 cases performed in pregnant women in the AOMI Project by the conventional technique, it was observed that complete molar endodontics was significantly lower, showing the importance of using mechanical techniques in these patients [32]. The use of this technique in root canal preparation and obturation with a single cone, with completion of all stages of treatment in a single session, reduces the working time and also contributes to a lower incidence of postoperative pain compared to manual files [16]. This technique also allows greater disinfection during root canal preparation, improving the working conditions for both professional and patient [16]. Despite the decrease in working time, in women with more advanced pregnancy, it is important to avoid supine

hypotension [5-6, 21] and to avoid worsening the breathing difficulties. Placing a pillow on the left side of the hip or turning to the left side from time to time and at completion of the procedure is essential. Also, after the third trimester, the pregnant woman should be considered a mouth breather in which the airway must be free.

It is important to remember that dental treatment is being conducted for two patients: mother and fetus [6], and the diaphragm is repositioned in a more superior position, decreasing the respiratory volume [12]. Thus, in the third trimester, it is important to work providing comfort by releasing the nostrils when using rubber dam isolation and not extending the consultation time, preferably performing a provisional restoration with glass ionomer cement. In the present cases there was no report of postoperative pain and the restoration was performed, being an important step in the success of endodontic therapy. The choice of restorative material during pregnancy is also important and composite resin was used in all presented cases, whose effect from the presence of polymers has been investigated and has not been associated with adverse results at birth [33].

Follow-up of an endodontic procedure is fundamental to evaluate its success. After delivery, the pregnant women remain in control at each visit of the baby. The absence of controls of the present cases is due to the fact that they were performed recently, and the main objective is to disclose the importance of endodontics in pregnancy. Thus, to improve the results of oral-systemic health for mothers and their newborns, it is essential to increase the professional knowledge, since it is clear that the health benefits of providing care during pregnancy outweigh the potential risks [24]. In addition, some women seek dental care and ignore that they are pregnant. Others do not report their pregnancy. Therefore, in the initial dental consultation, every woman in childbearing age should be considered pregnant until otherwise proven [12]. The presence of a pregnant tummy cannot preclude the accomplishment of dental prenatal care and, whenever necessary, the professional should contact the obstetrician.

## CONCLUSION

The use of apex locators and mechanical instrumentation, using reciprocating files associated with the obturation technique with a single standardized cone for each system, represent advances for the performance of endodontic treatment in pregnant patients due to the shorter clinical time and greater comfort of the procedure. The taboos and myths regarding dental care during pregnancy are still present among pregnant women and health professionals, including dental professionals. Research and clinical studies are necessary to continue spreading knowledge for the development of new health policies that increasingly include dentistry during pregnancy, favoring the health of women and their children.

## Collaborators

ARAÚJO LP was the endodontist that was responsible for performing the clinical procedures and writing the manuscript, XAVIER SR, HARTWIG AD and AZEVEDO MS conducted the critical revision of the content, PAPPEN FG and ROMANO AR carried the final composition of the article and supervised the clinical procedures.

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