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Comparison of ultrasound Fiberglass Pin Removal using or not using Operating Microscope

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Abstract*— *Endodontics seeks to sustain teeth whose pulps, for some reason, have lost the quality of maintaining vitality or have become necrotic. Careful attention should be paid to cases of root canal infection as the solution for these cases is very difficult. The aim of this study was to compare the removal of fiberglass pins with ultrasound inserts using or not an operating microscope. Twenty human mandibular premolars were selected, instrumented with the Logic 25/06 system and irrigated with 2.5% sodium hypochlorite (NaOCl). The canals were dried, filled and the specimens stored in distilled water (maintained at 36.5°C and 100% humidity). Unobturation was performed until 5 mm of filling material remained in the apical region. The glass fiber retainers, previously selected, were cemented with an ED Primer adhesive system and Panavia F resin cement, then the samples were stored for 24 hours at 37°C. Subsequently, the dental elements were divided into two groups for the removal of intraradicular retainers with 25 IRRI S ultrasound insert: G1 - removal of fiberglass posts with ultrasound insert without microscope and G2 - removal of fiberglass posts with ultrasound insert without microscope. Subsequently, all teeth were subjected to longitudinal section in the mesiodistal direction with a 22 mm double-faced diamond disk, coupled to a straight piece and a micromotor cooled with air/water spray. After this procedure, an operating microscope at 12.5X magnification was used to verify the rest of the fiberglass post in the cervical, middle and apical thirds. G2 showed better results than G1 in removing the fiberglass post in the three root thirds. It is possible to conclude that the removal of the intraradicular retainers with ultrasound and microscope offer better results.

I. INTRODUCTION

The study is about comparing the removal of the fiberglass post with ultrasound using or not an operating microscope. It is noteworthy that a communicable disease that has several factors is dental caries, especially caused by excessive use of sugars, an element that causes the demineralization of the tooth surface caused by fermentation of carbohydrates and bacteria that infect the oral cavity (NEWBRUM, 1988). Thus, tooth decay causes tissue loss and chronic inflammatory situations, acute with degenerative character and also pulp death, thus requiring endodontic treatment (FIGUEIREDO et al., 2003).

Endodontics seeks to sustain teeth whose pulps, for some reason, have lost the quality of maintaining vitality or have become necrotic. Special attention must be paid to cases of root canal infection, as the resolution of this case is quite difficult (MELO, 2015).

Despite being widely employed with high success rates (NAUMANN et al., 2012; SARKIS-ONOFRE et al., 2014), there may be indigence of abscission of this retainer for access to the root canal and new endodontic/restorative treatment. Among the causes of failures are retainer loosening/decementation, retainer fracture/root restoration, tooth decay, periodontal disease, endodontic problems, short retainers and root fragility.

In order to have access to the root canal in the absence of partial or complete fillings, abscission of the retainer is important without excessive removal of dentin, perforation or fracture of the remaining tooth, so that a conservative endodontic treatment can be carried out, preserving the maximum amount of remnant healthy coronary and root (BERBERT et al., 2012).

Among the methods for abscission of the intraradicular retainer, there is the use of cutting ultrasonic tips and their associations (SOARES, 2009). It is one of the most widespread removal techniques. Among the methods prior to that mentioned, the tensile action methodology was used that acted through wear, such as drills, which acted on the cement line, causing tension and allowing its rupture, such as the use of ultrasound or the combination of drills and ultrasound. The use of ultrasound has the advantage of applying less force for removal, as the vibrations act on the cement line, causing its rupture (GARRIDO et al., 2009).

To perform this procedure, the operating microscope can be used, a device that has been widely used in Endodontics with the scope of minimizing the obscurity of the operative field, as it allows for high magnification and brightness, enabling the effective methods and providing a higher quality result (PELOTAS, 2017).

This is an easy-to-work instrument, as it is suitable for the office as it is a portable device and its size is favorable for handling. However, it should only be used who are knowledgeable about the techniques, as when it is used quickly, the learning curve will be short, given this fact, the operating microscope is a device of greater complexity and therefore must be used with dexterity. (WEST, 2016).

A little used, but very important function of this device, taking into account the intermediary of the coupled peripherals, is the camera/video, due to the fact that it is a great ally to be adapted together with the documentation of all clinical cases, which facilitates so that the scrub nurse has greater predictability of the case, thus increasing the chances of success in endodontic therapy (FERREIRA et al., 2010). This material, in addition to serving as a way to record the procedure, can also be performed as learning material and as a way of providing legal protection, safeguarding the surgeon's and patient's rights.

Due to the adversities at the time of removal of the fiberglass post and the lack of precise studies regarding the choice of the best technique to remove them, it is necessary to carry out standardized studies (IZZELI et al.,2020). Thus, the objective of this study is to compare the removal of fiberglass pins with ultrasound inserts using or not an operating microscope, aiming to perform a more effective procedure, with more clarity, sharpness and seeking to minimize errors when removing the intraradicular retainer.

The aim of this study was to compare the removal of fiberglass pins with ultrasound inserts using or not an operating microscope.

II. METHODOLOGY

The study is an applied research, where its approach is quali-quantitative, exploratory in character, carried out on extracted human teeth.

The study was conducted using teeth donated by patients from the clinic and laboratory belonging to the Department of Dentistry of Instituto Tocantinense Presidente Antônio Carlos in Porto Nacional from February to March 2021.

Thirty human premolar premolars with single canals with apical root, transverse cross-sections straight and circular in the cervical, middle and apical thirds and similar diameters measured in millimeters of wireless Schick CDR digital radiography (Schick Technologies, Inc, Long Island City) were used. , New York, United States) (used at 60 kVp, 10 mA and (1/6 sec), then the largest and smallest diameters of the buccolingual root canal were measured in each third of the root (cervical, middle and apical) using a digital caliper. If a root canal displayed oval cross-section in two of the three thirds, were classified as oval and included in the sample.

Root scaling was performed with periodontal curettes (Duflex – SS White – Rio de Janeiro – Brazil), extracting any and all dirt on the external surface. The specimens were inspected with pumice (SS White – Rio de Janeiro – Brazil) and water, using Robinson brushes (KG Sorensen – Rio de Janeiro – Brazil) connected to a counter angle with a micromotor (Kavo, Joinville , Brazil). The specimens were deposited in 0.1% Timol (Manipulation Pharmacy – Formula and Action – São Paulo – SP) and remained for a period of no more than three months (MARQUES et al., 2012, MARQUES et al., 2020).

After cleaning, the crown section of the teeth was carried out in the amber/cementary connection with a 22 mm double-faced diamond disc (Fava, São Paulo, Brazil), joined to the straight piece and the micromotor (Kavo, Joinville - SC - Brazil) refreshed with air/water spray. The extension of the roots was standardized in 15 mm with the assistance of an endodontic calibrating ruler (Dentsply/Sirona, Tusla - USA). A 10 k file (Dentsply/Sirona, Tusla - USA) was placed in advance to verify possible interventions with catheter movement.

This process was carried out with the Prodesign Logic 25/06 motor and rotary system (Easy, Belo Horizonte – Brazil), followed by the preparation of the cervical third with a Prodesign Logic 06/25 file (Easy, Belo Horizonte – Brazil) towards the crown – apex respecting the canal anatomy, always maintaining a minimum distance of 5 mm from the apical limit on radiography and in curved canals until the beginning of curvature.

Afterwards, odontometry was performed with a type K 10 file (Dentsply/Sirona, Tusla - USA) where it was placed in each canal until it was visualized in the apical foramen. The working length was determined at 1 mm below the apical foramen. Then, a Prodesign Logic 25/06 file (Easy, Belo Horizonte – Brazil) instrumented 1mm short of the real length of the tooth.

In the process, the instrumentation consisted of irrigating with 2.5% sodium hypochlorite (Manipulation Pharmacy – Formula and Action – São Paulo – SP), 10 ml Lüer Slip plastic syringe (Advantive, Nanchanc Jangxi - China) and 25 x 0 disposable needle .55 (BD, Curitiba - PR). 30 ml of solution were used per experimental unit. The needle was placed throughout the instrumentation process until reaching 2 mm less than the working length.

The canals, at the end of preparation, were dried with capillary tips (Ultradent Products, Inc, South Jordan, Utah, USA) joined to a high-powered sucker and with absorbent paper cones (Tanari, Manacapuru - AM).

Final irrigation was performed with 3 ml of 17% EDTA (Manipulation Pharmacy – Formula and Action – São Paulo – SP). Initially, 1 ml of 17% EDTA was placed, accompanied by ultrasonic vibration with a 25 IRRI S insert (VDW; Endo Ultrasonic Files, Endodontic Synergy, Munich, Germany) at a frequency of 30 kHz. The ultrasound insert was connected to a piezoelectric ultrasound acting at 30 kHz (CVDent 1000; CVD Vale, São José dos Campos, SP, Brazil), glued at power level 3, in a time of 20s. This process was repeated 2 more times. After this method, irrigation was performed with 5 ml of sodium hypochlorite (Farmácia Formula & Ação, São Paulo - SP. The canals were dried with capillary tips (Ultradent Products, Inc, South Jordan, Utah, USA) attached to a sucker high power and with absorbent paper cones (Tanari, Manacapuru - AM).

The filling cement was used with AH Plus (Dentsply/Siorna, Munich, Germany) and spatulated according to the manufacturer's instructions.

After handling the endodontic cement, the canals were filled, in a single session, using the Continuous Wave Condensation technique (Buchanan, 1994), which adopts the principles of Schilder's technique (1967) using the Touch'n Heat equipment. For this purpose, M and FM accessory cones (Tanari, Manacapuru - AM) were chosen. These were measured using a calibrating endodontic ruler (Dentsply/Maillefer, Ballaigues - Switzerland) and adapted to the working length. The Touch'n Heat thermoplasticizer will cut, plastify and thicken the gutta percha inside the canals, up to 10 mm, inside the root canal. This phase of the filling is known as "Down Packing".

The specimens were analyzed under an operating microscope (M 9000 DF Vasconcellos SA – São Paulo) at 12.5X magnification, right after the root canal filling process, to check if any filling material (guta percha and/or endodontic cement) will be present. present within 10 mm after using Touch'n Heat. If the existence of remaining filling material is verified, a probe altered for endodontics (Golgran, São Paulo - SP), or automated metallic condenser or Gates-Glidden drills (Dentsply/Maillefer, Ballaigues - Switzerland) will be used for its abscission.

White Post DCE n° 1 prefabricated pins (FMG Produtos odontológico LTDA – Joinville - SC) were used. The preparation for the post will be carried out with existing drills in the White Post DCE kit n° 1 (FMG Produtos odontológico LTDA – Joinville - SC), in the 11 mm of the root canal, in lateral movements. These drills are compatible with the diameter of each pin used.

The posts were cleaned before cementation with isopropyl alcohol and the silane will be applied for 60s Silane (PROSIL- FGM Produtos odontológico LTDA – Joinville – SC with micro brushes (Microbrush, Grafton - USA)).

Initially, it was necessary to test the fiberglass posts to adapt them to the prepared channels. Etching with phosphoric acid (Condac 37% FGM, Joinville - Brazil) was carried out inside the channel for 15 s. After this process, irrigation was performed in a disposable syringe with distilled water for 30s to remove the acid. The root canal was dried with absorbent paper cones. The application of the ED Primer adhesive system (Kuraray, Tokyo, Japan) was carried out according to the manufacturer's instructions. The cementation material (Panavia - Kuraray, Tokyo, Japan) was introduced with a lentulum (Dentsply/Maillefer, Ballaigues - Switzerland), the post was inserted into the root canal and the excess material was removed. Light curing was carried out for 60 s (on all sides of the pin) using the

Optilight LD MAX Curing Unit (127V/220V), power – 600m Wcm2, (Gnatus, Ribeirão Preto - SP). After this procedure, the exposed part of the fiberglass post was sectioned with a 22 mm double-faced diamond disc (Fava, São Paulo, Brazil), coupled to a straight piece and a micromotor (Kavo, Joinville – SC – Brazil) cooled with air/water spray.

The dental elements were randomly divided into two groups for removal of retainers with ultrasound inserts:

G1 (N = 10) - Removal of the fiberglass post without an operating microscope:

The 25 IRRI S ultrasound insert (VDW; Endo Ultrasonic Files, Endodontic Synergy, Munich, Germany) was connected to a piezoelectric ultrasound operating at 30 kHz (CVDent 1000; CVD Vale, São José dos Campos, SP, Brazil), fixed at power level 2. Subsequently, the fiber post was used to remove it inside the root canal towards the crown – apex and buccolingual laterality, respecting the anatomy of the root canal until reaching 10 mm of the root canal and observed the gutta percha. Visual inspection of the removal of the intraradicular fiberglass post was performed. If a remnant is observed, the ultrasound insert was used again until complete removal is noticed.

G2 (N = 10) - Removal of the fiberglass post with an operating microscope:

The 25 IRRI S ultrasound insert (VDW; Endo Ultrasonic Files, Endodontic Synergy, Munich, Germany) was connected to a piezoelectric ultrasound operating at 30 kHz (CVDent 1000; CVD Vale, São José dos Campos, SP, Brazil), fixed at power level 2. Subsequently contacted the fiber pin to remove it inside the root canal in the coronal direction – apex and buccolingual laterality, respecting the anatomy of the root canal until reaching 10 mm of the root canal and observing the gutta percha. The entire procedure was used with an operating microscope (M 9000 DF Vasconcellos S.A. – São Paulo) at 12.5X magnification. Visual inspection of the removal of the intraradicular fiberglass post was performed. If a remnant was observed, the ultrasound insert will be used again until the total removal is noticed.

All teeth were subjected to longitudinal section in the mesiodistal direction with a 22 mm double-faced diamond disc (Fava, São Paulo, Brazil), joined to a straight piece and a micromotor (Kavo, Joinville – SC – Brazil) and freshened with air spray /Water. Subsequently, this method was used with an operating microscope (M 9000 DF Vasconcellos S.A. – São Paulo) at 12.5X magnification to visualize the remnant of the fiberglass post in the cervical, middle and apical thirds.

Disposal of the materials used in this study were placed in a hospital waste bag (Azeplast Indústria e Comércio Ltda., Santa Cataria – Brazil), made in accordance with ANVISA standards, after completing the laboratory procedures for this research. The hospital waste bag, with biological material, was presented to Fapac/Itpac Porto Nacional's biological hazardous material disposal sector for disposal, in accordance with ANVISA regulations.

Data analysis was performed according to the Content Analysis method represented by tables and/or Excel graphs, duly substantiated according to the literature.

III. RESULTS

After this procedure, an operating microscope at 12.5X magnification was used to verify the rest of the fiberglass post in the cervical, middle and apical thirds. G2 showed better results than G1 in removing the fiberglass post in the three root thirds. (Figura 01 e 02).

Fig.1: Removal of the intraradicular retainer without the microscope
Source: Own authorship

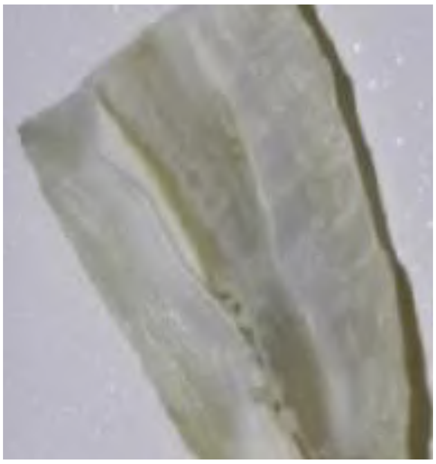

Fig.12: Removal of the intraradicular retainer with the microscope
Source: Own authorship

IV. DISCUSSION

The analyzes of this study demonstrated that the use of ultrasonic devices and a microscope to remove fiberglass posts is of high satisfaction to endodontic professionals. However, Assis (2020) reported in his studies that there are several techniques for removing intraradicular posts available to professionals, and all with the same objective, to be efficient, simple and, especially, to remove the intraradicular post without generating iatrogenic damage. In this study, it was observed that the use of an operating microscope with ultrasound inserts minimized the occurrence of deviations and promoted a better removal of fiberglass posts.

In addition, the studies by Gesi et al., (2018), conducted a study to determine the effectiveness and efficiency of various removal techniques for fiberglass posts, using ultrasound as one of the removal methods. They concluded that diamond tips and ultrasound need more time to remove the pins, however, their effectiveness in removing debris inside the canal was greater than in other techniques. In the present study, the 25 IR S ultrasound insert was used, which was effective in removing the intraradicular retainers in the root canals. However, the group that used an operating microscope promoted greater removal of fiberglass posts in the root walls in all thirds.

Cruz and Salomão (2020) evaluated the effectiveness and efficiency of different removal techniques, using kits in a different group of pins from manufacturers, with diamond tips with a Peeso drill. They found that the two techniques were effective in removing the chicks, but more effective in the group where the diamond tips and the Peeso drill were connected. For Baltieri (2020) the use of diamond tips, clinical microscope and ultrasound in the removal of pins showed a variation between 03 and 20 times of efficiency.

For Lira et al., (2017), the use of ultrasound and an angled diamond tip allowed a better visual in the operative phase, which would not be possible with high rotation and is a technique that has been used in several studies and researches for treatment endodontic and as a facilitator of the execution of certain methodologies, including the removal of fiberglass posts. Corroborating the studies mentioned above, Silva et al., (2019) emphasize that the non-surgical retreatment in endodontics is effective if compared directly with the technique of removal of all material connected with the root canal systems filled and, when the tooth has an intraradicular pin, so it needs to be removed with care.

Assis (2020) emphasizes that to remove intraradicular pins, techniques that offer low risks of perforation and fractures, which are easy to perform and simple are needed. Thus, the author indicates the use of ultrasound for this type of removal as it preserves the remaining tooth structure. Menezes et al., (2019) describe the ultrasound technique for use in all teeth, confirming the minimal loss of the possibility of occurrence of perforations, tooth structure and root fractures. Remembering that the ultrasonic energy is transmuted to the root retainers, breaking the cement line between the wall of the root canal and the post.

Freire (2018) corroborates the authors' preference for the ultrasonic system due to efficiency and safety, as it does not require mechanical force against the walls of the tooth root, preventing fractures and the leverage effect. Cruz and Salomão (2020) demonstrates that ultrasonic devices fall into two classes, magnetostriction, transforming electromagnetic energy into mechanical energy, generating intense heat, and piezoelectric, using a crystal that transmutes the volume when an electrical charge is used. Also according to the author, the crystal is deformed and converted into mechanical oscillation, causing a minimal amount of heat, and that the piezoelectric class is the most recommended in endodontics, offering greater efficiency and effectiveness in energy transformation, reducing the unwanted impacts of the process and generating less heat.

Silva et al., (2019) say that the use of ultrasound with a microscope, as it is electronic, can offer some disadvantages and affect its efficiency, as they are subject to failures. In the studies by Cruz and Salomão (2020), the best existing ultrasonic devices, tested in their research, was the ENAC® (Osada Electric Co, Japan) due to its easy use and good efficiency. Another factor is that this equipment has an ST 09® tip, which is used in the removal of intraradicular retainers and comes with the equipment.

In the view of Lira et al., (2017), one way to assess the efficiency and effectiveness of removing fiberglass posts is the ultrasound with a microscope and the diamond tips with a longer period, removing all debris and emptying the channel compared to other employed techniques and protocols.

V. CONCLUSION

It is possible to conclude that the removal of the intraradicular retainers with ultrasound and microscope offer better results.

REFERENCES

[1] ASSIS, Diogo Sabugueiro de. **Considerações clínicas no momento da remoção e um pino intrarradicular.** Artigo de

revisão bibliográfica. Faculdade de Medicina Dentária. Universidade do Porto. Porto, 2020.

[2] BALTIERI P. Fundamentos essenciais na remoção de pinos pré-fabricados não metálicos: onde a magnificação faz a diferença In: Murgel C, Ferreira CA, Worchech C. **Microodontologia:** visão e precisão em tempo real. Editora Dental Press, 2020, 482p.

[3] BERBERT F, CRISCI F, BERBERT A, BONETI FILHO I, VAZ L. Efeito do desgaste da linha de cimento, da vibração ultrassônica e da associação de ambas sobre a força de tração empregada na remoção de pinos intrarradiculares. **Rev Odontol UNESP** 2012; 31(2):215-29.

[4] CRUZ, Jeane Sousa; SALOMÃO, Marcos Botelho. A utilização do ultrassom na endodontia. **Revista Cathedral**, v. 2, n. 3, p. 75-83, 2020.

[5] FERREIRA, HLJ, PAULA, MVQ, GUIMARÃES, SMR, GONÇALVES, RCL. Avaliação radiográfica de obturações de canais radiculares. **Revista Odonto Ciencia**. Porto Alegre, v. 22, n. 58, p. 340-345, 2010.

[6] FIGUEIREDO FED, MARTINS-FILHO PRS, FARIA-E-SILVA AL. Do Metal Post–retained Restorations Result in More Root Fractures than Fiber Post–retained Restorations? A Systematic Review and Meta-analysis. **JOE.** 2003; 41(3): 309-16

[7] FREIRE, Ângelo Menezes. Tratamentos. 2018. Disponível em: **https://www.angelofreireendodontia.com.br/tratamentos/remocao-de-pinos.html.** Acesso em: 08 de set de 2021.

[8] GARRIDO A, FONSECA T, ALFREDO E, SILVA--SOUZA Y, SOUSA-NETO M. Influence of ultrasound, with and without water spray cooling, on removal of posts cemented with resin or zinc phosphate cements. **J Endod** 2009; 30 (3):173-6

[9] GESI A, MAGNOLFI S, GORACCI C, FERRARI M. Comparison of two techniques for removing fiber posts. **J Endod.** 2018. 29(9):580-2.

[10] GIL, Antônio Carlos. **Métodos e técnicas de pesquisa social.** 5. Ed. São Paulo: Atlas, 2010.

[11] IZZELI, N.; BERGANTIN, E.; ALOVISI, M.; PASQUALINI, D.; BERUTTI, E. Evaluation of a simplified fiber post removal system. **Journal of Endodontics**, v.39, n.11, p.1431-4, 2020.

[12] LIRA, L. B. A. de et al. ULTRASSOM E SUAS APLICAÇÕES NA ENDODONTIA: Revisão de literatura. **Rvacbo**, [s.l.], v. 27, n. 1, p.80-89, 2017. Disponível em: <www.rvacbo.com.br/ojs/index.php/ojs/article/view/370/440>. Acesso em: 20 set. 2021.

[13] MARCONI, M.A, LAKATOS, EM. **Fundamentos de metodologia científica**. 5.ed. São Paulo: Atlas,2011.

[14] MARQUES, J. N.; GONZALES, C. B.; SILVA, E. M.; PEREIRA, G. D. S.; SIMÃO, R. A.; PRADO, M. Análise comparativa da resistência de união de um cimento convencional e um cimento autoadesivo após diferentes tratamentos na superfície de pinos de fibra de vidro. **Rev Odontol UNESP**. 2012;45(2):121-126.

[15] MELO S. Pinos estéticos: qual o melhor sistema? **Arqu bras odontol**. 2015; (3):179-84.

[16] MENEZES, M. M. et al. O uso do ultrassom na remoção de retentores intraradiculares com diferentes tipos de retenção. **Revista Odonto Ciência**, v. 24, n. 1, p. 45-48, 2019.

[17] NAWMAN M, YAMAN P, DENNISON J, RAF- TER M. Fracture resistance of endodonti-cally treated teeth restored with composite posts. **J Prosthet Dent** 2012; 89(4):360-7

[18] NEWBRUN, E. **Cariology.** 2nd ed. Baltimore: Williams & Wilkins, 1988.

[19] PELOTAS, R. Complications of endodontically treated teeth restored with fiber posts and single cr**owns or fixed dental prostheses-a systematic review.** Clinical Oral Investigations, v.20, n.7, p.1449-57, 2016.

[20] SARKIS-ONOFRE R.; JACINTO R de C, BOSCATO N.; CENCI M. S.; PEREIRACENCI T. Cast metal vs. glass fibre posts: a randomized controlled trial with up to 3 years of follow up. **J Dent**, v. 42, n. 5, p. 582-7, 2014.

[21] SILVA MR, BIFFI JCG, MOTA AS, FERNANDES NETO AJ, NEVES FD. Protocolo para remoção dos pinos de fibra de vidro: revisão de literatura**. ROC,** v.3, n.1, p 30-36, 2019.

[22] SOARES J A. Influence of luting agents on time required for cast post removal by ultrasound: an in vitro study. **J Appl Oral Sci** 2019;17(3):145-9.

[23] WEST, J D.B. Cleaning and shaping the root canal system. In: COHEN, S; BURNS, R. C. (Edit.) **Pathways of the pulp.** 7 ed. St. Louis: Mosby, 2016. p.203-257.