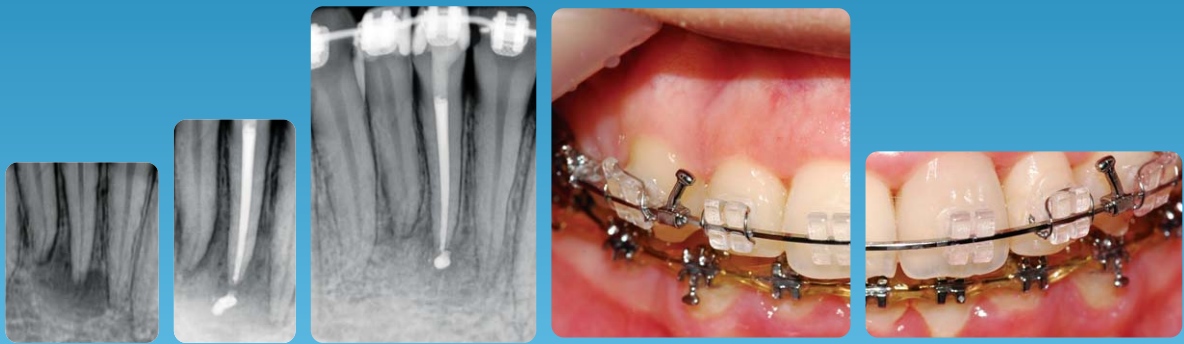


대한치과근관치료학회지

The Journal of Korean Academy of Endodontics



Endodontic consideration in orthodontic treatment (p123)



Vol 11, No 2, 2011

대한치과근관치료학회

교정치료에 있어서 근관치료학적 고려사항

신동렬
강남루덴치과

ABSTRACT

ENDODONTIC CONSIDERATION IN ORTHODONTIC TREATMENT

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Endodontic treatment is sometimes accompanied by orthodontic treatment. However, there are many controversies about the interrelation between these treatments. Furthermore, clinicians can be frustrated when they encounter related complications. This article describes endodontic considerations in orthodontic treatment by means of discussing several cases and previous studies. [J Kor Acad Endod 2010;11(2):123-131]

Key words: endodontic, orthodontic force, pulp, root resorption

-Received November 19, 2010; revised November 22, 2010; accepted November 25, 2010-

1. 서 론

현재 근관치료와 교정에 관하여 뚜렷하게 근관치료학 교과서나 교정학 교과서에 따로 장을 구별하여 다루어진 것은 매우 적다. 상세한 정보 역시 많이 부족한 상태이며 많은 문헌들에서 상반된 의견을 내는 경우도 많이 있다.¹ 따라서 교정 중 치수괴사가 일어난다거나 과도한 치근 흡수 등이 일어난 경우, 많은 교정과 선생님들께서 당황하고 환자와의 관계가 많이 안 좋아진 상태에서 보존과로 의뢰되는 경우가 빈번하다. 자주 일

어나지 않는 부작용이기 때문에 의료사고라고 인식되는 경우도 있다. 또한 치근단 병소를 가진 경우, 근관치료 후 언제 교정 치료를 들어갈 것인지, 교정 중 환자가 치아과민증을 호소하는 경우에 어떻게 해야 할 지 등의 많은 결정의 순간에 적절한 결정을 하기가 쉽지 않다. 이에 그동안 의뢰된 증례와 문헌 등을 통해서 교정 치료 시 근관치료학적 고려 및 교정치료 중 발생한 여러가지 문제점의 해결에 관하여 논하고자 한다.

II. 본 론

1. 교정과 치수와의 관계

교정력이 치아에 가해지면 치수는 혈류량과 미세혈관수가 증가하면서 hyperemia 상태가 된다. 미세혈관수의 증가는 교정력과 관련이 있으며 교정력이 증가할수록 그 수가 더 증가하게 된다. 따라서 치수괴사는 교정력과 밀접한 관련이 있다고 할 수 있다.² Oppenheim 등은 심한 tipping 시 치수변성이 거의 모든 치아에서 일어나는 것을 발견하였고, 이러한 경우 collateral circulation이 적은

것을 확인하였다. Light intermittent forces를 주고 손상 에 대한 치유 기간을 부여할 것을 권고하였다 (그림 1-5).³

교정력에 의해 치수가 괴사되는 경우는 대부분 치근단공이 닫혀있는 상태이다. 치근단공이 완



그림 1. 교정 전 치근단 방사선 사진.

성되지 않은 경우에는 치수가 영향을 받는 경우는 극히 적다. 교정력이 치수에 가하는 영향은 우식이나 외상과 같은 예전의 치수 상태에 많은 영향을 받는다. 따라서 교정중 외상 병력, 우식, 수복물, 치주질환을 가진 치아의 경우에 치수의 비가역적인 변화가 나타나거나 치수괴사가 일어날 확률이 높다. 또한 이러한 치아들은 교정과 더불어 외상성교합, 치주염 등 hyperemia를 일으킬 수 있는 가능성도 염두하여 치료를 진행하면서 치수손상을 최소화 할 수 있어야 한다 (그림 6-8).

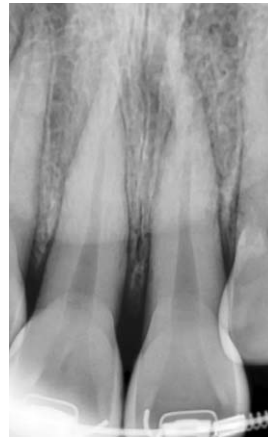


그림 3. 변색이 된 후의 방사선 사진. 교정 초기에 발생했기 때문에 치근흡수는 관찰되지 않는다.

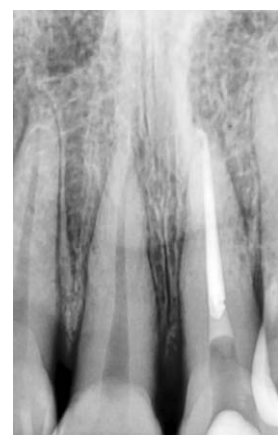


그림 4. 근관충전 후의 치근단 방사선 사진



그림 2. #21의 변색 및 치수괴사가 일어난 후의 임상사진. #21 치아에 open-coil이 상당히 많은 교정력을 꾸준히 가했음을 볼수 있다.



그림 5. 실활치 미백 후의 임상사진. 근관치료와 관계없이 교정치료는 지속적으로 진행하였다.



그림 6. 교정 전 파노라마 사진. #16, 36, 36이 오래전 발치된 증례로 6개의 구치를 traction하여 공간을 상쇄하려 했기 때문에 이 동량과 치아에 가해지는 양이 많을 수 밖에 없는 증례이다.



그림 7. 교정 종료 후의 파노라마 사진. #35, #38 치아 모두 치수과사를 동반한 치근단 병소가 관찰된다. #35 치아는 교정정 광범위한 우식치료를 시행하였고 #38 치아의 이동량 뿐만 아니라 uprighting 과정 중 외상성 교합까지 가해져 치수과사를 야기한 것으로 사료된다.



그림 8. #38 근관충전 치근단 방사선사진. 치수 괴사는 있었으나 치근흡수는 거의 없었기 때문에 근관치료의 큰 어려움은 없었다.

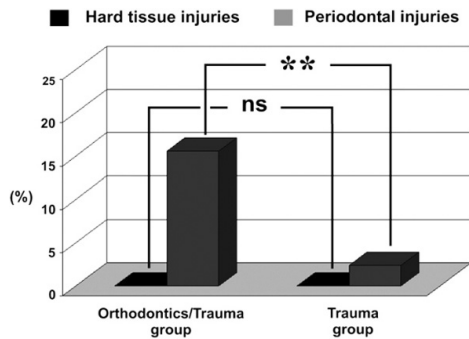


그림 9. 외상과 교정이 같이 이루어진 경우 치수괴사가 더 많이 일어났다. 경조직에 관련된 외상은 교정 후에도 치수괴사가 일어나진 않았다.

특히 이중 외상병력을 가진 치아는 치수가 괴사되는 경우가 빈번하기 때문에 교정치료 중에도 주기적으로 치수생활력을 관찰을 해야한다 (그림 9).⁴

교정치료 도중 치아의 과민증을 호소하는 경우, 상아질이 노출되어 호소하는 과민증이 아니라면 1주일 정도 그 치아에 교정력을 가하지 않고 치유기간을 부여하여야 한다. 교정력을 가하지 않으면 72시간 내에 원래의 치수혈류량을 회복한다는 내용이 있지만 pulpal respiration response가 1주일 후에도 완전히 회복되지 않는다는 보고도 있다. 만약 환자의 치아 과민증이 사라지지 않았으나 변색 등 치수괴사의 증거가 보이지 않는 경우에는 1주일 정도 더 교정력을 가하지 않고 지켜보는 것이 더 올바른 판단이라 사료된다 (그림 10-11).⁵

2. 근관치료와 교정력에 의한 치근흡수와 의 관계

Cwyk 등은 28.8%의 치아에서 교정 후 치아흡수를 보였다고 보고하였다.⁶ 완전히 밝혀지지 않았으나 강한 힘이 합입이나 tipping 방향으로 가해진 경우 많았으며 blunt하거나 pipette 형태의 상악 중절치에서 많이 일어난다고 하였다.⁷ 치근흡수는 11세 이후에 교정을 시작한 경우에 나타나고 고정식 장치가 가철식 장치에 비해 심하게 일어난다. 근관치료를 받은 치아가 더 많은 흡수를 보인다고 보고한 문헌이 있는 반면, Spurrier 등은 치근흡수를 보인 증례 중 근관치료된 치아와 생활치를 비교한 결과, 생활치에서 더 많은 치근흡수를 보인 것을 보고하였다.⁸ Mirabella 등, 역시 근관치료된 치아의 치근흡수가 적음을 보고하



그림 10. 교정 후 치아변색된 임상사진. 투명교정 후 1주일 만에 변색이 되어 의뢰된 증례이다.



그림 11. 실활치 미백 후의 사진. 너무 강한 힘이 가해지도록 장치가 제작되었고 치아과민증이 있었음에도 불구하고 환자가 지속적으로 착용하여서 발생한 치수괴사로 사료된다.



그림 12. 교정 전의 파노라마 사진

였다.⁹ 그러나 이와 반대로 Esteves 등은 근관치료된 치아와 생활치의 치근흡수는 유의성 있는 차이가 없음을 보고하였다.¹⁰ 따라서 교정중 과도한 치근흡수가 있다고 해서 의도적 근관치료와 수산화칼슘을 이용한 long-term dressing과 같은 치료는 옳바르지 않다고 사료된다. 1983년 Mattison 등은 교정 중 과도한 치근 흡수가 발생하여서 생활력이 있음에도 불구하고 근관치료하여 수산화칼슘 침착하였고 이로인해 흡수가 중지하였다고 보고하였다.¹¹ 하지만 현재 이러한 치료에 대해서는 동의할 수 없다 (그림 12-16).



그림 13. 교정전 세팔로 사진. 전치부의 치축을 보면 교정력이 tipping movement 방향으로 많이 가해질 수 밖에 없음을 관찰할 수 있다.

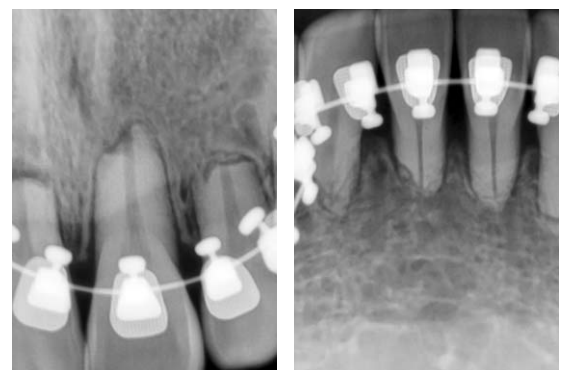


그림 14. 교정 도중 환자 방사선 사진. 치근 흡수가 과도하게 일어났음을 관찰할 수 있다. 교정 치료가 설측으로 이루어졌기 때문에 더욱 교정력 조절이 어려웠을 것이라 사료된다.

그림 15. 하악전치부의 치근단 방사선 사진



그림 16. 교정 종료후 2년 follow-up 파노라마 사진. 더 이상의 치근흡수는 진행되지 않았고 환자도 큰 불편감 없이 사용하고 있다.

Wickwire 등은 외상에 의해 근관치료를 한 경우에는 치근의 흡수량이 생활치에 비해 많이 일어난다는 것을 보고하였다.¹² 하지만 근관치료된 치아나 생활치 모두 이동량은 동일하다 (그림 17).



그림 17. 외상병력을 가진 환자의 치근단 방사선 사진. 중절치의 흡수 가능성을 고려하여 교정을 보류하였다.

또한 생활력을 상실하는 경우도 외상병력을 가진 경우가 많았다. 하지만 그 후 연구에서 외상 후 근관치료를 받은 치아의 경우, 기존의 흡수가 없다면 흡수량이 차이없다는 보고가 있었기 때문에 외상받은 치아역시 충

분히 교정력으로 치아를 이동시킬수 있다.¹³

3. 교정과 근관치료 예후와의 관계

교정전 병소가 있는 경우, 기존 교정교과서에 서는 근관치료 후 치유를 기다린 후 교정치료를 시작하라고 하였으나 비록 이동이 늦어지긴 하나 교정치료가 치유를 방해하지 않는다고 보고하였다 (그림 18).¹⁴ 따라서 치근단 병소가 있는 경우, 근관치료가 완료되었다면 바로 교정치료에 들어가도 관계없다. 또한 교정치료 중 치근단 병소가 발견된 경우 역시 교정과정 중에 치료하여도 치유에 영향을 미치지 않는다 (그림 19-21).



그림 18. 치근단 병소가 있었으나 근관치료 후 교정치료를 바로 들어간 후 치유된 양상을 볼 수 있다 (Courtesy by Dr. Pyung-Sik Kim).

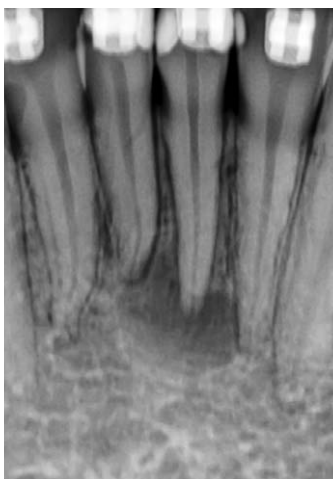


그림 19. 교정 중 인접면 우식으로 인해 치수괴사 및 치근단 병소를 보이는 치근단 방사선 사진 (Courtesy by Dr. Pyung-sik Kim).



그림 20. 근관충전 치근단 방사선 사진.



그림 21. 근관치료 후 5개월 방사선 사진. 교정 치료 중 병소가 치유됨을 볼 수 있다.

다만 치수괴사와 더불어 치근흡수를 보인다면 치아이동이 급격히 이루어지는 시기에는 수산화칼슘 첩약을 통해 조금이나마 치근흡수를 막을 수 있도록 하고 치아이동이 어느정도 정지한 후 충전을 하는 것이 도움이 된다고 할 수 있겠다. 또한 교정 중 치수괴사가 생긴 경우, 교정치료 자체가 치근흡수를 동반하는 경우가 많기 때문에 치근단 협착이 없어지는 경우가 많다 (그림 22-25). 근관장 측정이나 큰 apical size로 인해 근관치료의 어려움이 발생할 수 있기 때문에 주의해야 한다.



그림 22. #21 변색을 보이는 임상사진



그림 23. 변색 후의 치근단 방사선 사진. 교정 마무리 단계에서 치아를 설측으로 놓기 위해 힘을 가하면서 치수괴사가 발생할 것으로 사료됨. 교정치료가 오랫동안 진행되었기 때문에 치근단 흡수를 관찰할 수 있다.



그림 24. 근관장 측정 사진. 치근단 흡수로 인해 치근단 협착이 사라지면서 근관장 측정기에 근관장이 짧게 측정됨.



그림 25. 근관충전 후의 치근단 방사선 사진. 근관충전이 방사선학적 근침에서 많이 떨어져서 이루어졌음을 관찰할 수 있다.

III. 결 론

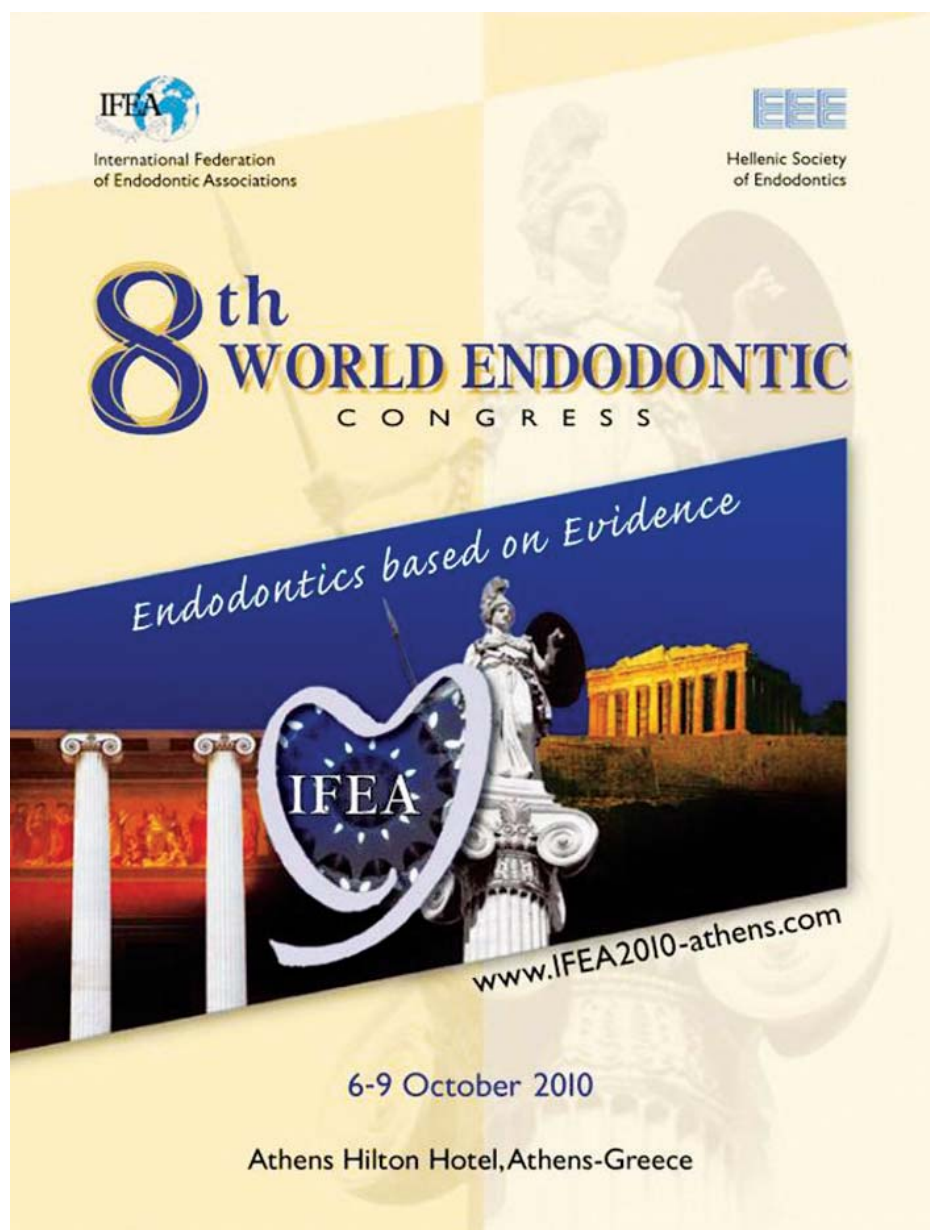
교정 전 문진, 임상검사를 통해서 혹시 교정 중 발생할 치수괴사, 치근흡수 등의 가능성에 대해서 인지해야 하는 것이 중요하다고 생각된다. 또한 교정 동의서 등에 치근흡수에 대한 이야기는 대부분?있는 데 치아변색이나 차후 근관치료 가능성과 같은 부작용은 많이 설명되지 않아 이러한 일이 발생했을 때 많은 교정과 의사가 어려움에 봉착하는 경우가 많다.

교정 중에는 의도하지 않게 치수괴사가 일어나는 경우가 종종 있으며 특히 수복물, 우식, 치주질환, 외상 등이 있다면 그 가능성을 더 증가되기 때문에 교정과 의사는 이러한 것을 고려하면서 치료해야 할 것이고 근관치료 의사는 차후 발생하는 부분의 해결뿐만 아니라 교정치료전 검사시 이러한 부분을 교정과 의사에게 전달해야 한다고 사료된다.

||| 참고문헌

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제8회 세계 근관치료학회 참가 보고서 및 참가 후기



2010년은 국제치과근관치료학회 연맹(International Federation of Endodontic Associations: IFEA) 창설 20년이 되는 해로 1990년 Mexico City, 1992년 Paris, 1995년 Rome, 1998년 Jerusalem, 2001년 Madrid, 2004년 Brisbane, 2007년 Vancouver에 이어 올해 10월6일부터 9일까지 그리스 아테네에서 제8회 세계 근관치료학회가 개최되었다. 이번 8회 세계치과근관치료학회(World Endodontic Congress)는 국제치과근관치료학회 연맹과 함께 그리스치과근관치료학회(Hellenic Society of Endodontics)가 공동 주관하였으며 “Endodontics based on Evidence” 를 주제로 하여 개최되었다.

IFEA 총 회원국 28개국과 비회원국 33개국 총 61개국이 참가하였으며 총 참가 등록인원이 1000여명에 달하였다. 이는 3년 전 캐나다 밴쿠버에서 개최되었던 7회 학회에서 55개국 1200여명의 참가에 준하는 규모로 전세계를 아우르는 근관치료학회의 위상을 재차 확인하는 계기가 되었다. 이번 8회 학회에서는 7편의 Keynote lecture를 비롯하여 25개국의 대표 초청강연 및 23건의 일반강연, 31건의 구연, 146편의 포스터 및 6건의 비디오 발표를 통한 논문 연구 및 증례 발표가 이루어졌다.

한국에서는 강릉원주, 경북, 경희, 단국, 부산, 연세, 전남, 조선대학교 및 삼성병원, 울산대학교병원에서 교수들과 전공의 및 석박사 과정 학생들이 30명 참가하였다. 이번 학회에서 연세대학교 정일영 교수는 “Young pulp! What should I do?” 라는 연제로 회원국 대표 초청강연을 하였으며 생활치수의 보존 술식에 대한 많은 관심과 호응을 받았다.

다음 제9회 세계 근관치료학회는 일본, 동경에서 2013년 5월 23일부터 26일까지 개최될 예정이다. 학회 마지막 날 열린 연차총회(Annual General Assembly Meeting)에서 차차기(10회) 세계근관치료학회는 유치 제안 발표와 경쟁 투표를 거쳐 남아프리카공화국 케이프타운에서 개최하기로 결정되었다. 특히, 이 회의에서 경북대학교 김성교 교수는 Secretary로 선출되어 앞으로 2년간 회장을 도와 IFEA의 업무를 맡게 되었다. 그 동안 본부임원으로 역할을 한 적이 있거나 하고 있는 나라는 미국, 이탈리아, 프랑스, 캐나다, 이스라엘, 호주, 영국, 그리고 벨기에이며 이번에 아시아 최초로 한국이 참여하게 된 것이다. 이는 한국의 치과근관치료학회 위상을 세계적으로 드높인 것이라고 할 수 있다. 이는 한국이 학문적, 임상적으로 아시아태평양 지역뿐 아니라 전 세계적으로 치과근관치료학 분야 국제학술대회의 단순 참가국의 역할에서 주도적 리더 국가로서의 역할을 이미 시작하였고 앞으로 이 역할을 더욱 강화해야 한다는 것을 의미한다. 그리고 이러한 국제적인 역할은 대한치과근관치료학회 회원들의 적극적인 관심과 참여를 바탕으로 할 것이다.

다음페이지에는 이번 8회 세계근관치료학회의 각 부문별 연자(Key-note lecture 초록 포함) 및 발표자와 제목을 나열하였으며, 한국에서 발표한 논문 혹은 증례의 초록을 게재한다.

2010. 10. 13.

대한치과근관치료학회 학술이사 / 부산대학교 치의학전문대학원 치과보존학교실

김현철

Key-note Speakers and Lectures

Prof. John Ingle, USA

“Sixty Years of Endodontics: Past, Present and Future”

Prof. Ken Hargreaves, USA

“An overview of Regenerative Endodontics”

Prof. Dr. Edgar Sch?fer, Germany

“An Evidence-based approach on mechanical preparation of the root canal system”

Prof. Paul V. Abbott, Australia

“Root Canal filling concepts, techniques and materials - do we have the evidence to support what we do?”

Prof. J. Craig Baumgartner, USA

“How Effective is Root Canal Debridement and Disinfection?”

Prof. Syngkuk Kim, USA

“Endodontic Microsurgery. An evidence-based approach”

Prof. Shimon Friedman, Canada

“The current best evidence for Endodontic Treatment Outcomes”

AN OVERVIEW OF REGENERATIVE ENDODONTICS

Prof. K. Hargreaves

Considerable excitement exists for developing dental applications that employ post-natal stem cells and concepts of tissue engineering. Although much remains to be done to advance this field, progress has been made in clinical regenerative endodontic procedures: literally, saving teeth by regenerating a pulp-dentin complex. This program will describe the current status of regenerative endodontic procedures, their potential and predictors of healing success. Both clinical and basic studies will be reviewed to provide the practitioner with the latest information on this field with an emphasis on practical steps to be apply these procedures in treating selected patients.

Objectives:

At the completion of this course, the practitioner should be able to:

1. Describe the three major steps in tissue engineering and how they apply to regenerating the pulp-dentin complex.
2. Understand the clinical principles needed for regenerative endodontic procedures.
3. Be able to describe clinical outcomes of successful regenerative endodontic procedures.

AN EVIDENCE-BASED APPROACH ON MECHANICAL PREPARATION OF THE ROOT CANAL SYSTEM

Prof. S. Schafer

This lecture provides a detailed comparison between hand instruments (both stainless steel and NiTi) and modern rotary NiTi systems. Based on a critical evaluation of the current literature, differences in shaping of even severely curved root canals, root canal cleanliness, and the tendency of the instruments to extrude debris into the periapical tissues between hand and rotary NiTi instruments will be pointed out. Based on the currently best available evidence, the impact of these instruments on the clinical outcome of root canal treatment will be discussed.

Moreover, the suitability of different types of root canal instruments for the management of some usual clinical problems (e.g., initial negotiating of sclerosed and/or severely curved root canals, bypassing of intracanal ledges, and enlargement of root canals with irregular cross-sections) will be assessed. Finally, a comparison of the pros and cons of these different types of instruments will be given to summarize the presentation.

ROOT CANAL FILLING CONCEPTS, TECHNIQUES AND MATERIALS ? DO WE HAVE THE EVIDENCE TO SUPPORT WHAT WE DO?

Prof. P. Abbott

Lateral condensation, lateral compaction, vertical compaction, thermoplastic techniques, warm lateral condensation, gutta percha, resin-based materials, cements, sealers, solvent softened techniques, carrier-based systems ? which should I use? Traditionally dentists have assessed endodontic treatment by viewing radiographs of the completed root canal filling. This is largely a result of early research projects that attributed “failure” of treatment to so-called “apical percolation”, even though those studies did not test this concept of “percolation”. They essentially graded root fillings on whether they completely filled the root canal or not, based on their radiographic appearance. This research then led to a plethora of studies that attempted to assess the “apical seal” of root canal fillings using a variety of methods but subsequent studies have demonstrated that the vast majority of these earlier works were invalid due to experimental errors and/or lack of controls. To date, no correlation has been established between the apical penetration of fluids and the clinical performance of root canal fillings. Despite all this, many changes and recommendations regarding root filling techniques, instruments and materials have been made with clinicians and manufacturers claiming superiority of their product or technique over others. More recently, the focus has shifted to the coronal restoration of the tooth and its effect on treatment outcome. In this presentation, some of the history behind the development of techniques and materials will be reviewed in light of the research. A review of the concepts of root canal fillings and why canals are filled will lead to a discussion of how root fillings can then be assessed in the clinical setting. What is the most important aspect of Endodontics ? is it the radiographic appearance of the root filling or is it how the final result is achieved? Do we have the evidence to show that one technique is better than another? What are we trying to achieve? If we can answer these questions, then perhaps Endodontics is not so complicated or difficult after all and we can concentrate on the important aspects of treatment rather than what makes it look nice!! But then ... the problem will be to change the thinking of the members of our profession who have for so long judged endodontic treatment from radiographs!

HOW EFFECTIVE IS ROOT CANAL DEBRIDEMENT AND DISINFECTION?

Prof. C. Baumgartner

Debridement and disinfection of the root canal system are key to successful endodontic treatment. Innovative research methods have recently discovered many previously unknown putative endodontic pathogens. We now know that the oral cavity is colonized with hundreds of species of bacteria. A selective process allows bacteria to colonize the root canals of teeth with exposed or necrotic pulps and produce an endodontic infection. In addition to bacteria, fungi, viruses, and possibly prions may be present in infections of a root canal system. These microbes can also exchange genes for various virulence factors. The population of microorganisms varies from one geographical area of the world to another and even from one person to another. Aggregates of microorganisms and the production of biofilms make root canal disinfection difficult.

Although instruments have greatly improved shaping of the canal system, we rely primarily on irrigation to clean (debride and disinfect) the root canal system. Innovative needles, apical controlled delivery systems, and the use of sonics or ultrasonics have been recommended. Sodium hypochlorite (NaOCl) remains the most commonly used irrigant; however, there is concern for the safety of the patient. Various concentrations of NaOCl have been evaluated for safety, efficacy of debridement, and ability to

disinfect the root canal system. Researchers have evaluated many irrigants including ethylene-diamine-tetra-acetic acid (EDTA), chlorhexidine, citric acid, MTAD, other solutions, and even ozone gas. In addition, the efficacy of lasers and other forms of photodynamic energy have been evaluated. An evidence-based approach will be used to compare and contrast the efficacy of various methods used for root canal debridement and for eradicating microbes from the root canal system.

THE CURRENT BEST EVIDENCE FOR ENDODONTIC TREATMENT OUTCOMES

Prof. S. Friedman

The outcome of endodontic therapy has been challenged because of inconsistent reports that contrast with the consistently favourable reports for implant-supported single-tooth replacement. This is particularly true for treatment of persistent endodontic disease by way of Retreatment and Apical Surgery. Consequently, clinicians often overlook these viable treatment procedures as being unpredictable.

The inconsistency of the endodontic outcomes reported has indeed caused considerable confusion in the dental profession. Two critical steps are required to eliminate this confusion: (1) The “success”, or outcome must be defined based on the goals of therapy, and (2) studies representing the current best evidence must be identified and used as reference for treatment outcomes.

This lecture will define the appropriate outcomes of endodontic therapy, identify outcome studies that comprise the current best evidence, and highlight the outcomes of endodontic treatment modalities - Initial Treatment, Retreatment, Apical Surgery - in regards to healing and asymptomatic function of the treated teeth. For each treatment modality, clinical factors will be discussed that may influence the outcome. In addition, selected Retreatment and Endodontic Surgery strategies and techniques will be highlighted, to illustrate the full scope of possibilities offered by these modalities.

IFEA COUNTRY REPRESENTATIVE SPEAKERS & TOPICS

Dr. Gabriela Martin / ARGENTINA

“Regenerative Endodontic Treatment with PRP”

Dr. Bill Kahler / AUSTRALIA

“Aspects of wear and tear of tooth structure”

Prof. Roland De Moore / BELGIUM

“Laser-tissue interaction in the root canal: getting rid of the limitations of the straight forwarded laser beam”

Prof. Manuel Eduardo de Lima Machado / BRASIL

“How Brazilian people are using rotary systems in Endodontics ? Amazon. Project: a social action”

Dr. Ian Watson / CANADA

“Conventional retreatment of failed root end surgeries”

Prof. Fabienne Perez / FRANCE

“How to adapt root canal disinfection to new knowledge in Endodontic microbiology?”

Prof. Dimitrios Tziafas/ GREECE

“Regeneration of the dentin-pulp complex: where are we and where are we going?”

Dr. Gopi Krishna / INDIA

“Current trends and future perspectives in Endodontic diagnosis”

Prof. Masoud Parirokh / IRAN

“Perforation repair in Endodontic practice”

Prof. Joshua Moshonov / ISRAEL

“Endoscope”

Prof. Giuseppe Cantatore / ITALY

“A critical approach to new NiTi instruments for mechanical glide path”

Dr. Misako Nakajama / JAPAN

“Complete regeneration of dental pulp by transplantation of dental pulp stem cells”

Prof. Il-Yong Jung 정일영 교수(연세대학교) / KOREA

“Young pulp! What should I do?”

Dr. Walid Nehme / LEBANON

“Non-surgical Retreatment: clinical strategies to avoid mishaps”

Dr. Armando Hernandez / MEXICO

“Geristore: Alternative apical sealer for microsurgery in Endodontics and it’s biocompatibility”

Dr. Mike Jameson / NEW ZEALAND

“Factors affecting the biomechanical properties of dentine”

Prof. Irina Makeyeva & Dr. Alexey Erohin / RUSSIA

“Computer tomography for Endodontic retreatment planning”

Dr. Eugenio Grano de Oro-Cordero / SPAIN

“Endodontic failures: how to avoid them”

Dr. Patrick Sequeira / SWITZERLAND

“Systematic reviews in Endodontology: Garbage collection or gold mine?”

Dr. Jeeraphat Jantararat / THAILAND

“Revascularization: Does it work?”

Prof. Hakan Sen / TURKEY

“Chlorhexidine in Endodontics”

Dr. Howard Lloyd / UK

“Rotary instrumentation: a clinician’s perspective”

Prof. Antonina Politun & Dr. Oleksandra Golovchanska / UKRAINE

“Apical preparation: problems and solutions”

Dr. Louis Rossman / U.S.A.

“Endodontics: thirty years in retrospect”

YOUNG PULP! WHAT SHOULD I DO?

Prof. Il Young Jung (Korea)

The immature teeth with apical periodontitis present considerable challenges to clinicians. Therefore, new treatment protocols have been suggested to overcome the problems encountered in traditional methods. Revascularization technique is one of such methods. Many case reports on the revascularization of infected immature teeth have been published, and in most of them, immature teeth with even a periapical abscess continued root formation after the disinfection of the root canal system. We now believe that this continued root formation is not an exceptional incident. As a result, it appeared that apexification has giving way to a revascularization technique, which is a new option, in treating necrotic immature teeth. These new methods appear to be based on the healing potential of young pulp. The potential of healing or regeneration of young pulps seems to be greater than we thought before. This presentation mostly consists of clinical cases, which all involve young pulps. Among them, revascularization cases are also included. However, the aim of this presentation is not going to solely address revascularization procedures, but to show how young pulps respond to various injuries or treatments. Therefore, I want to share my clinical experiences on the fate of young pulps, and I look forward to helping you understand the pathways of the young pulps.

POSTER PRESENTATIONS from KOREA (Abstracts)

P 017

AUTOTRANSPLANTATION OF TEETH WITH COMPLETE ROOT FORMATION

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Aim: Autotransplantation is a viable option for treating missing teeth when a donor tooth is available. This study reports the success rate of 19 autotransplantations of molars with complete root formation.

Methods: The study was conducted on 19 patients (11 males and 8 females), each of whom had a molar transplanted. The mean age was 38.5 years (range 19-67). Computer Aided Rapid Prototyping (CARP) was used in the cases that 3D CT image was available. Autogenous bone or allogenic bone was implemented around the transplanted tooth after transplantation, and with the recipient site close to the maxillary sinus, septal bone sinus augmentation was performed before transplantation. There were some cases in which the donor tooth was rotated for the initial fixation. The transplanted third molars were stabilized with silk sutures or resin-wire splint for 2-3 weeks. In 6 cases, endodontic treatment was carried out before transplantation and this was done 1 or 2 weeks after the transplant for the other 13 cases. Postoperatively, marginal and periapical conditions were examined clinically and radiographically.

Results: 16 cases were performed to the standard, resulting in an 84% success rate.

Conclusions: In spite of the fact that the donor tooth may have complete root formation, autotransplantation can be a satisfactory treatment option with a high success rate when performed according to a strict case selection and treatment protocol.

P 033

THE EVALUATION OF CANAL CURVATURE AT MERGING POINT IN TYPE II MESIAL CANALS OF MANDIBULAR MOLARS

Yun H., Hwang H., Yun A.

Department of conservative dentistry, Chosun University, Gwang-ju, KOREA

Aims: The mesial canals of mandibular molars coalesce to form one major foramen with abrupt angle in 49% of the cases. The file to navigate the abrupt curvature will be forced possibly leading to instrument separation. The purpose of this study is to evaluate the curvature at merging point in Vertucci's type II mesial canals of mandibular molar using the radius and angle of curvature.

Methods: A total of 115 mandibular molar teeth were selected without making any age and sex discrimination. Following a standard endodontic access in the teeth, their distal roots were removed and 10 or 15 file were introduced into the mesiobuccal and mesiolingual canals of the teeth. We took radiographs of the teeth in the bucco-lingual view and mesio-distal view. Root canals were classified according to Vertucci's classification. In our study, we selected Vertucci's type II and divided two subgroup; IIa and IIb. Specimens of two subgroup were examined the radius and angle of curvature. The results were statistically analyzed using ANOVA test at $p < 0.05$ level.

Results: In Vertucci's type IIa group, radius of mesiolingual canal curvature were significantly smaller than mesiobuccal canal. But, no significant correlation was seen in Vertucci's type IIb group. On the angle of curvature, there were no significant differences in both groups.

Conclusions: In Vertucci's type IIa, ML canals are more abrupt curvature in merging point. Therefore, the clinician should consider the abrupt curvature of type II mesial root in mandibular molars to prevent the instrument separation.

P 054

COMPARISON OF TORSION RESISTANCE AND FRACTURE TOUGHNESS OF NICKEL-TITANIUM ROTARY FILES

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Aims: The aim of this investigation was to compare torsional resistance and fracture toughness of various Nickel-Titanium (NiTi) rotary files.

Methods: Five NiTi rotary instruments with different cross-sectional geometries were selected: TF and RaCe with equilateral triangle, ProTaper with convex-triangle, ProFile with U-shape, and Mtwo with S-shape. The size of TF, RaCe, ProFile, and Mtwo files was #25/.06 taper, and the ProTaper F1 files were tested. The ProTaper F1 was selected for having the same diameter as with other files at D5. A metal block with a 5 mm³-cubical hole was constructed in which 5 mm of the file tip was rigidly held in place by filling the mold with a composite. The files were subjected to rotational torque at 2rpm using torsion tester. The torque and angular distortion were plotted until file failure. The data were statistically compared for yield-strength, ultimate-strength, plastic hardening period and fracture toughness. Results: TF and Race had significantly lower yield-strength than other systems. TF had significant lower ultimate-strength than other files and Mtwo showed the highest. ProFile had the highest distortion angle and TF was the next. ProFile showed the highest fracture toughness while TF and RaCe showed the lower toughness than others.

Conclusions: Under the limitations of the present study, the five tested NiTi rotary files have different mechanical behaviors under torsional load.

P 056

AN EVALUATION OF ROTATIONAL STABILITY IN ENDODONTIC ELECTRONIC MOTORS

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Aims: The purpose of this study was to evaluate a rotational stability of endodontic electronic motors by comparing the changes of rotational speed, depending on the number of usages and with/without static load.

Methods: Twelve new endodontic electronic motors were used in this study. Non contact type digital tachometer was used for measuring the rotational speed of handpiece. True RMS Multimeter was used for measuring the voltages and the electric currents. All measurements were recorded every 10 seconds during 10 minutes and repeated 9 times. Five repetitions were done per each electronic motor. For statistical analysis, student t-test, repeated measures and Scheffe's post-hoc tests were performed

Results: Except AEU-25, actual rotational speed of all electronic motors showed lower than configured rotational speed and actual rotational speed of all electronic motors showed significant differences from configured rotational speed. In the same motor group, there was no significant difference in all measurements. In all groups, there was no significant difference in the amount of rotational speed changes depending on the number of usages and with/without static load. In static loading condition, Endomate TC showed lower rotational speed than that of unloaded, X-Smart and Endomate TC showed higher electric currents than that of unloaded.

Conclusions: within the limitations of this study, the results showed that all kinds of endodontic electronic motors had an established rotational stability. Therefore they could be safely used in root canal treatment with a reliable maintenance of rotational speed, regardless of the number of usages and with/without load.

P 059

EFFECT OF DIFFERENT FLUTE DESIGN AND SURFACE TOPOGRAPHY OF NICKEL-TITANIUM ROTARY INSTRUMENTS ON THEIR FATIGUE RESISTANCE UNDER CYCLIC FLEXURAL STRESS

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Aims: This study compared the effect of different flute design and surface topography of nickel-titanium (NiTi) rotary instruments on their cyclic fatigue resistance using a dynamic fatigue tester.

Methods: A total of 120 NiTi rotary instruments (ISO 25/.06 taper) from 6 brands (HeroShaper, K3, Mtwo, ProTaper, Revo-S, and TF) were rotated in a simulated root canal (angle of curvature of 60° and a radius of curvature of 5 mm) with pecking motion. The number of cycles to failure (NCF) was calculated. The data were statistically analyzed by One-way ANOVA and Tukey HSD test. All fractured surfaces were analyzed to determine the fracture mode using a scanning electron microscope.

Results: The value of NCF was the highest in TF (2164.6 ± 476.2) and decreased in the order of HeroShaper (1719.0 ± 294.3), Mtwo (1664.5 ± 205.9), ProTaper (1638.0 ± 132.3), Revo-S (1418.4 ± 298.3), and K3 (1330.4 ± 241.2) respectively. Fractographically all fractured surfaces showed the coexistence of ductile and brittle properties.

Conclusions: TF showed significantly higher fatigue resistance than any of other systems under experimental conditions.

P 060

THE EFFECT OF HYDROFLUORIC ACID SURFACE TREATMENT ON CYCLIC FATIGUE RESISTANCE OF THREE NICKEL-TITANIUM ROTARY INSTRUMENTS

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Aims: Recently the surface topography of nickel titanium (NiTi) rotary files has received particular attention in the aspect of fatigue failure. This study evaluated the effect of hydrofluoric acid surface treatment on the cyclic fatigue resistance of three NiTi rotary instruments.

Methods: ProFile (Dentsply), K3 (SybronEndo), and TF (Sybron Endo) were used. Each of these files (n=10) were treated with hydrofluoric acid for 90 seconds and the cyclic fatigue resistance was measured by a dynamic fatigue tester which can measure the number of cycles to fracture (NCF) before and after the acid treatment. Acid treated surface was examined under scanning electron microscope (Hitachi). The data were statistically analyzed by Mann-Whitney test.

Results: Although there was no statistically significant difference, K3 and TF showed increased cyclic fatigue resistance, whereas ProFile showed decreased cyclic fatigue resistance after acid treatment. Acid treated surface showed smoothening of surface irregularities in K3 and TF. However, in ProFile, the acid treated surface showed pitting defects on the surface.

Conclusions: Surface treatment with hydrofluoric acid may have a positive effect on increasing the cyclic fatigue resistance of K3 and TF.

P 080

THE COMPARISON OF DIFFERENT CANAL IRRIGATION METHODS TO PREVENT REACTION PRECIPITATE OF SODIUM HYPOCHLORITE AND CHLORHEXIDINE

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Aims: The purpose of this study was to compare the different canal irrigation methods to prevent the formation of precipitate between sodium hypochlorite (NaOCl) and chlorhexidine (CHX).

Methods: 50 extracted human single-rooted teeth were used. The root canals were instrumented by NiTi rotary file (Profile .04/#40) with 2.5% NaOCl and 17% EDTA as irrigants. Teeth were randomly divided into four experimental groups and one control group as follows; Control group: 2.5% NaOCl only, Group 1: 2.5% NaOCl + 2% CHX, group 2: 2.5% NaOCl + paper points + 2% CHX, Group 3: 2.5% NaOCl + one size larger preparation + 2% CHX, Group 4: 2.5% NaOCl +95% alcohol+ 2% CHX. The teeth were split in bucco-lingual aspect and the specimens were observed using Field Emission Scanning Electron Microscope. The percentages of remaining debris and patent dentinal tubules were determined. Statistical analysis was performed with one-way analysis of variance (ANOVA). Energy Dispersive x-ray Spectroscopy was used for analyzing the occluded materials in dentinal tubule for elementary analysis.

Results: There were no significant differences in percentage of remaining debris and patent tubules between all experimental groups at all levels. In elementary analysis, the most occluded materials in dentinal tubule were dentin debris and NaOCl/CHX precipitate was detected in one tooth specimen of Group 1.

Conclusions: there were no significant precipitate on root canal, but suspected material was detected on Group 1. Therefore, caution should be exerted to avoid direct contact between NaOCl and CHX.

P 085

ASSESSMENT OF THE CONCENTRATION OF HEBP SOLUTION; SMEAR LAYER REMOVAL EFFECT, TISSUE DISSOLVING EFFECT, AND ANTIMICROBIAL ACTIVITY

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Aims: The purpose of this study was to assess the correlation between the concentration of HEBP/NaOCl solution and the effect of smear layer removal, tissue dissolving, and antimicrobial activity.

Methods: 120 intact bovine central and lateral incisors were extracted from frozen jaws, placed in 0.9% saline. The crown and apical 7mm of the roots were removed and the roots were prepared to cylindrical test specimens 5mm (± 0.1 mm) in height. Only root cylinders of at least 6.5 mm diameter were used to provide enough dentin. After instrumentation, specimens were immersed with 3% NaOCl, 17% EDTA, 3%, 6%, 9%, 12% HEBP for 2 minutes. Then, specimens were split longitudinally and evaluated with SEM. (2) Tissue dissolving assay. Tissue specimens were obtained from bovine tissue. Weight loss of pulp tissue specimens incubated in testing solutions was measured over time (0, 15, 30, 60, 90, and 120 minutes). The testing solution was 17% EDTA and 3, 6, 9, 12% HEBP mixed 3% NaOCl to a 1:1 ratio (w/w). Results are expressed as the percent of original tissue weight. (3) Antimicrobial activity test. *Enterococcus faecalis* (ATCC 4083) cells were cultured in 10ml Tryptic Soy Broth for 24 hours at 37°C. Antimicrobial testing was performed on filter papers. The control group was distilled water and the testing group was 3% NaOCl, 17% EDTA and 3, 6, 9, 12% HEBP mixed 3% NaOCl to a 1:1 ratio(w/w). The filter paper disks were then incubated in these solutions at 37°C for 3, 30, and 300 minutes. The total number of CFUs was calculated from dilutions.

Results: The NaOCl group did not remove the smear layer and HEBP 3, 6 group were lower than HEBP 9, 12 group, and EDTA group in smear layer removal ($p < 0.05$). The NaOCl group showed higher tissue dissolution capacity than other groups, EDTA group showed the lowest level of tissue dissolution and HEBP 3, 6, 9 group showed higher tissue dissolution capacity than HEBP12 group after 60 minutes ($P < 0.05$). In the antimicrobial activity test using *E. faecalis*, NaOCl group and HEBP 3, 6, 9, 12 group killed $>99.9\%$ of bacteria but EDTA group had no effect ($p < 0.05$).

Conclusions: For the smear layer removal, tissue dissolving effect, and antimicrobial effect, 9% HEBP/NaOCl solution is recommended.

P 086

**ASSESSMENT OF THE HEBP/NaOCl SOLUTION TO REMOVE THE SMEAR LAYER,
DISSOLVE TISSUE , AND DISSINFECT THE CANAL SYSTEM**

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Aims: The purpose of this study was to compare the properties of tissue dissolution, smear layer removal, and antibacterial activity between EDTA/NaOCl and HEBP /NaOCl solutions.

Methods: Tissue specimens were obtained from bovine pulp tissue. The efficiency of smear layer removal of irrigants was examined with eighty extracted human teeth containing one canal. The capacity of tissue dissolution of irrigants was measured by performing the test with mixture of different concentrations of EDTA, HEBP, and NaOCl for indicated incubation times. Antibacterial efficiency of irrigants was tested against *Enterococcus faecalis* (*E. faecalis*) and *Porphyromonas endodontalis* (*P. endodontalis*). Instrumentation with 0.06 taper K3 Rotary Ni-Ti files using crown-down technique was followed by root canal irrigation with 5 mL of irrigants for 2 minutes. The teeth were splitted longitudinally at the apical 1/3 and middle 1/3 level of the root canal and were examined under SEM at x 2,000.

Results: NaOCl group showed higher tissue dissolution capacity than other groups ($p < 0.05$). EDTA group demonstrated low level of tissue dissolution capacity. However, the HEBP 9 group demonstrated higher tissue dissolution capacity than other groups ($p < 0.05$). NaOCl, HEBP 9, and HEBP 18 groups demonstrated over 99.9% antibacterial activity against *E. faecalis* and *P. endodontalis*. However, EDTA group did not exhibit antibacterial activity ($p < 0.05$). No significant difference in smear layer removal was shown between all experimental groups ($p > 0.05$). However, the HEBP 9 group demonstrated a lower capacity on smear layer removal than that shown by the EDTA and HEBP 18 groups ($p < 0.05$).

Conclusions: The present study demonstrated that the combination of 9% HEBP and NaOCl can be used chairside, instead of EDTA as irrigant to remove the smear layer and pulpal tissue.

P 087

EFFECT OF LIQUID AND PASTE-TYPE CHELATORS ON SMEAR LAYER REMOVAL DURING ROTARY CANAL PREPARATION

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Aims: The aim of this study was to evaluate, in vitro, the effect of a liquid and paste-type chelator on smear layer removal during rotary root canal preparation.

Methods: Human mandibular single root premolars with curvatures less than 30° were selected and decoronated. The roots were grooved along the buccal and lingual surfaces by using a diamond disc and randomly distributed into 4 groups of 20 teeth. The teeth were instrumented with K3TM rotary Ni-Ti files and irrigation was performed with 3% NaOCl after each Ni-Ti file. RC-Prep as a paste-type chelator and 17% pure EDTA as a liquid-type chelator were used during preparation. Four regimes described below;

Group NaOCl+NaOCl: NaOCl irrigation during Ni-Ti preparation, final irrigation with NaOCl. **Group RC-Prep+NaOCl:** RC-Prep during Ni-Ti preparation, final irrigation with NaOCl. **Group EDTA+NaOCl:** 17% EDTA during Ni-Ti preparation, final irrigation with NaOCl. **Group NaOCl+EDTA:** NaOCl during Ni-Ti preparation, final gradual irrigation with 17%EDTA. The specimens were cleaned with saline and dried, then splitted longitudinally. The amount of smear layer removal was evaluated under SEM on the apical $\frac{1}{3}$ and middle $\frac{1}{3}$ levels of the root canal and scored.

Results: Group NaOCl+NaOCl did not remove the smear layer. At the middle $\frac{1}{3}$ canal level, there was statistically significant difference among all experimental groups except Group EDTA+NaOCl and NaOCl+EDTA. Group EDTA+NaOCl and NaOCl+EDTA showed to be more effective at the middle $\frac{1}{3}$ level of the canal compared to the other groups. At the apical $\frac{1}{3}$ canal level, the increasing order of the effectiveness of the groups on smear layer removal is: Group RC-Prep+NaOCl, NaOCl+EDTA and EDTA+NaOCl(p<0.05). Group EDTA+NaOCl and group NaOCl+EDTA showed higher smear layer removal than other groups at the apical $\frac{1}{3}$ of the canal.

Conclusions: The present study concluded that the effect of smear layer removal from the instrumented canals by paste-type chelator was significantly decreased compared to that using final flush of 17% EDTA as a final flush or EDTA during canal preparation. Considering the effect on smear layer removal, proper irrigation sequence should utilise liquid-type chelator (EDTA) during canal preparation.

P 110

CHEMICAL CONSTITUTION, PHYSICAL PROPERTIES AND BIOCOMPATIBILITY OF EXPERIMENTALLY MADE NOVEL PORTLAND CEMENT

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Aims: The aim of this study is to produce the experimental Portland cement for dental use as a substitute of MTA and compare the physical properties and biocompatibility of experimental Portland cement with those of MTA and Portland cement.

Methods: Four cements were examined; experimental Portland cement, experimental Portland cement plus calcium sulfate, white MTA (ProRoot? MTA, Denstply Tulsa Dental, USA), white Portland cement (White Portland cement? Union white cement industrial Co. LTD., Korea). The constitution of the cements was determined by SEM and EDAX. Phase analysis was carried out using XRD. Phase identification was accomplished by the use of search-match data base, ICSD (Inorganic Crystal Structure Database, KISTI). The setting time was determined with a Vicat apparatus. Compressive strength was tested after 1, 3, 7 days using a Universal testing machine (Instron 4302) with a cross-head speed of 1mm min⁻¹. Biocompatibility was evaluated using by SEM and XTT assay.

Results: The experimental Portland cement was shown to have similar constitution to ordinary Portland cement. The setting time of experimental Portland cement was significantly shorter than that of MTA and Portland cement. Compressive strength of experimental Portland cement was lower than that of MTA and Portland cement. The experimental Portland cement showed a satisfying biocompatibility similar to that of MTA.

Conclusions: The present study supports that experimental Portland cement would be a potential endodontic material. However, it needs further study to improve the mechanical strength and demonstrate its clinical use

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PHYSICAL AND CHEMICAL PROPERTIES OF MINERAL TRIOXIDE AGGREGATE MIXED WITH GLASS IONOMER CEMENT

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Aims: The purpose of this study was to evaluate the setting time, compressive strength, and solubility of mineral trioxide aggregate (MTA) mixed with glass ionomer cement (GIC) and compare them with those of MTA, GIC, IRM, and SuperEBA.

Methods: Depending on the MTA and GIC powder mixture ratio, experimental groups were divided into 3 categories (1:1, 2:1, and 1:2 groups). GIC liquid was mixed with powder instead of sterile water. MTA, GIC, IRM, and SuperEBA were used to compare the properties. Setting time and compressive strength were measured by ISO 9917 methods. Solubility was determined by ISO 6876 standard.

Results: The setting time of MTA mixed with GIC was significantly shorter than that of MTA. The compressive strength of MTA mixed with GIC was significantly smaller than those of other materials at all time points and showed no significant difference as immersion time increased. The solubility of MTA mixed with GIC was significantly higher than those of other materials or similar to that of MTA.

Conclusions: The physical and chemical properties of MTA mixed with GIC appear similar to those of other four materials or somewhat inferior to those in some aspects. To be clinically feasible, further investigation on biocompatibility is essential and it is necessary to find the proper mixing ratio to enhance the physical and chemical properties.

P 112

EFFECTS OF BLOOD CONTAMINATION TO SURFACE HARDNESS AND

MICROLEAKAGE OF MTA

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Aims: The purpose of this study was to evaluate the surface hardness and microleakage of mineral trioxide aggregate (MTA) specimens following exposure to blood during hydration.

Methods: ProRoot MTA (Dentsply Tulsa Dental) was mixed according to manufacturer's instructions and packed into teeth in which canal preparation was completed using crown-down technique and then filled with continuous wave technique, following root-end resection and ultrasonic cavity preparation. Ten teeth were prepared and randomly divided into two groups of five samples each. One group was soaked in blood immediately after mixing. A moisture cotton pellet was placed on specimens of another group (control group). Both groups were stored at room temperature. Three days later, the specimens were removed and processed for microhardness test by using Knoop diamond indenter and microleakage was observed under SEM.

Results: Based upon these results, the surface hardness of MTA, which was exposed to blood, has decreased during hydration. The modification of microstructure was observed and the microleakage was increased in MTA, which was exposed to blood, according to SEM images.

Conclusions: Decrease of surface hardness, the increase of microleakage and the modification of microstructure were occurred in MTA, which was exposed to blood during hydration. Contrary to prior belief, setting condition during hydration can affect the properties of MTA.

P 137

**THE ADHESION BETWEEN FIBER POSTS AND COMPOSITE RESIN CORES:
THE EVALUATION OF MICROTENSILE BOND STRENGTH FOLLOWING DIFFERENT
TREATMENTS OF THE POST SURFACE**

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Aims: The purpose was to evaluate the influence of post-surface treatment with hydrogen peroxide, hydrofluoric acid or sandblasting and to investigate the effect of silane on the microtensile bond strength between fiber posts and composite resins.

Methods: 32 glass-fiber posts (FRC-Postec, Ivoclar-Vivadent, Schaan, Liechtenstein) and composite resin (Tetric-Flow, Ivoclar-Vivadent, Schaan, Liechtenstein) were used. Posts were divided into eight groups as different surface pretreatments were performed. These include: silane application (group 1); immersion in hydrogen peroxide (28%) for 10 min (group 2); immersion in hydrogen peroxide followed by application of silane (group 3); immersion in hydrofluoric acid (4%) gel for 60 sec (group 4); immersion in hydrofluoric acid gel followed by application of silane (group 5); sandblasting with aluminum oxide (group 6); sandblasting followed by silane application (group 7). In group 8, no surface treatment was performed (control). Composite resin was applied on posts to produce cylindrical specimens with the post in the center. It was sectioned for microtensile bond strength test. Statistical analysis was performed with two-way ANOVA and LSD test.

Results: Post-core strengths in group 6 and 7 were significantly higher ($p < 0.05$) than the control group whereas the silane, hydrogen peroxide and hydrofluoric acid groups were not significantly different. Group 7 showed significantly higher ($p < 0.05$) post-core strength than group 6.

Conclusions: Post pretreatment with sandblasting enhanced the interfacial strength between fiber posts and core materials. Moreover, sandblasting followed by application of silane was more effective with an improved clinical performance.



필자의 호텔 객실 창에서 바라 본 아크로폴리스(파르테논 신전)의 야경



기념 선상 만찬에서 근관치료학의 살아있는 역사이자 증인인 John Ingle 교수(올해 92세)와 함께하고 있는 김현철(부산대학교), 염지완(부산대학교치과병원), 하진희(울산대학교병원) 교수(좌로부터).

대한치과근관치료학회지 투고규정

1. 투고자격

대한치과근관치료학회 회원, 근관치료학과 그 관련분야 연구자의 원저, 증례보고 및 종설 등을 게재한다.

2. 원고의 제출처 및 제출 시기

원고는 대한치과근관치료학회 편집장에게 제출한다. 원고의 제출 시기는 특별히 정하지 않으며, 원고가 제출된 순서와 재고 진행상황에 따라 본 학회지 일호의 분량이 넘는 경우에는 차호에 게재한다.

편집장에게 질문이 필요한 경우 연락처는 다음과 같다.

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3. 원고의 종류

본 학회지는 원저, 증례보고, 종설, 독자의견, 학회 소식 등을 게재한다. 위에 속하지 않은 기타 사항 및 광고 등의 게재는 편집위원회에서 심의 결정한다.

4. 연구윤리 및 책임

대한치과근관치료학회지는 인간 및 동물실험

에 따른 연구윤리 문제에 대해 대한민국 교육인적자원부와 학술진흥재단의 연구윤리 가이드라인을 준수하며 이차 게재와 이중 게재에 대한 대한의학학술지편집인협회의 지침을 준수한다. 본 학술지에 실린 논문을 포함한 제 문헌에서 밝히고 있는 의견, 치료방법, 재료 및 상품은 저자 고유의 의견과 보고이며, 발행인, 편집인 혹은 학회의 의견을 반영하고 있지 않으며 그에 부수되는 책임은 원저의 저자 자신에게 있다.

5. 원고의 언어

원고는 국문 또는 영문으로 한다. 초록은 반드시 영문으로 작성하고, 맞춤법과 띄어쓰기를 정확히 하여야 한다. 용어는 공식 학술 용어를 사용하며 이해를 돕기 위해 괄호 속에 원어나 한자를 기입할 수 있다. 국문 용어가 없을 경우 원어를 그대로 사용한다. 약어를 사용할 경우에는 본문 중 그 원어가 처음 나올 때 원어 뒤 괄호 속에 약어를 표기하고 그 이후에 약어를 사용한다. 초록에서도 동일하다. 표(table), 그림설명(figure legend), 참고문헌(reference)은 영문으로 한다.

6. 원고의 저작권

제출된 원고를 편집위원회에서 재고 및 편집함에 있어 당 원고가 본 학회지에 게재될 경우 저작권은 본 학회지에 있다.

7. 동의의 획득

연구 대상이 사람인 경우 연구의 성격, 과정, 위해성 등이 충분히 고지된 상태에서 연구 대상

인 사람의 동의는 물론 연구윤리위원회(IRB)의 승인을 얻어야 하며 논문 투고 시 반드시 첨부하여 제출하여야 하고 투고 논문의 재료 및 방법에도 이에 관한 문구를 반드시 명시하여야 한다. 동물 실험이 포함된 경우에도 소속기관, 혹은 국가에서 정한 지침을 따라서 진행되었음이 명시되어야 한다. 이미 출판된 자료나 사진 등을 직접 인용할 경우 원 저자로부터 동의를 얻어야 한다. 아직 발표되지 않은 자료나 타 연구자와의 개인적인 의견 교환을 통해 입수한 정보를 인용할 경우 원 저자로부터 동의를 얻어야 한다. 인식 가능한 인물 사진 등을 인용할 경우 당사자로부터 동의를 얻어야 한다. 원고의 제출 시 위 사항에 대해 본 학회지에서는 원고의 저자가 당사자의 동의를 획득한 것으로 간주하며, 이에 대한 책임은 원고의 저자 자신이 진다.

8. 원고의 구성

모든 원고는 독자의 편이를 위해 가능한 한 간결하게 기술하여야 한다. 이를 위해 표와 그림을 포함하여 원고의 분량은 원저의 경우 A4용지 25쪽, 증례보고의 경우 13쪽 이내로 제한한다. 단위와 기호, 그림, 표, 참고문헌 등의 표기법은 치과 근관치료학회지의 예시를 참조하여 통일되게 작성한다.

1) 표지

제목 (국문투고 시 국문, 영문 모두 표기), 저자명, 학위, 직위, 책임저자 표기(*) 및 모든 저자의 소속을 표기하며, 하단에는 책임저자의 소속, 직위, 주소, 전화 및 전송 번호, E-mail 주소를 표기한다.

2) 초록

초록은 국문 또는 영문으로 작성하여 제출한다. 연구의 목적, 연구 재료 및 방법, 결과, 결론을 소제목으로 사용하여 국문 500자, 영문 250단어 이내로 간결하게 기술한다. 초록의 말미에는 6개 이내의 주요 단어 또는 key word를 국문 초록에서는 국문으로, 영문 초록에서는 영문으로 표기한다. 단, 국문 원고의 경우 영문 초록에는 제목, 저자명, 책임저자의 표기 및 그 소속이 별도로 영문으로 표기되어야 한다.

3) 서론

연구의 의의와 배경, 가설 및 목적을 구체적으로 기술한다. 이를 위해 다른 논문을 인용되 서론의 기술에 필요하며 학계에서 인정되고 있는 필수적인 논문을 가급적 제한하여 인용한다.

4) 연구 재료 및 방법

재료와 술식 및 과정을 기술하며, 독창적이거나 필수적인 것만을 기술한다. 통상적인 술식 및 과정으로 이미 알려진 사항은 참고 문헌을 제시하는 것으로 대신한다. 상품화된 재료 및 기기를 표기할 때에는 학술적인 명칭을 기록하고 괄호 속에 상품의 모델명, 제조회사명, 도시, 국가명을 표기한다.

5) 결과

결과는 총괄적으로 기술하며 필수적이고 명확한 결과만을 제시한다. 표, 그림 등을 삽입하여 독자의 이해를 돕고, 결과의 기술을 간략하게 하며, 세부적인 수치의 열거는 표와 그림을 인용함으로써 대신한다. 국문 원고의 경우에도 표와 그림에 대한 설명의 언어는 영어로 하며 SI (Le

système International d'Unités) 단위와 확대율 등을 정확히 표기한다. 표, 그림 및 그림설명은 별도로 작성하여 제출하거나 원고 내에 결과가 기술되는 면에 포함될 수 있으나, 칼라인쇄의 경우는 원고의 말미에 첨부할 수 있다.

6) 총괄 및 고안

서론의 내용을 반복하지 않도록 하고, 결과의 의미와 한계에 대해 지적하며, 편견을 줄이기 위해 타 연구의 결과와 어떻게 다른지 반대 견해까지 포함하여 기술한다. 마지막 단락에 전체적인 결론을 간략하고 명확하게 정리하고, 필요한 경우 연구의 발전방향을 제시한다.

7) 감사의 표시

연구비 수혜 내용과 저자 이외에 연구의 수행에 도움을 준 대상에 대한 감사의 내용을 참고 문헌 앞에 기술할 수 있다. 다만, 연구비 수혜 내용은 편집 과정에서 논문의 첫 페이지 책임저자 연락처 아래에 표기한다.

8) 참고 문헌

인용 순서대로 본문에서는 일련번호의 어깨 번호를 부여한다. 본문에서 저자명을 표기할 때는 성만을 표기하며, 저자가 2인 이상인 경우 성 사이에 '과(와)' 또는 'and' 를 삽입하고, 3인 이상인 경우 제1저자의 성만을 표기하고 그 뒤에 '등' 또는 'et al.' 을 표기한다. 참고 문헌은 영문으로 작성하며, 인용 잡지명의 약자는 Index Medicus의 예 및 통상적 관례에 따르고 양식은 기존의 학회지의 스타일에 따른다.

9) 기타

종설은 근관치료학에 관련한 특정 주제로 하

되 개인적인 의견이 아니라 근거에 기반을 둔 결론을 도출하도록 한다. 증례 보고의 양식은 서론, 치료과정, 총괄 및 고안으로 하는 것을 권장한다. 독자투고란에는 근관치료학에 관련된 이슈에 대한 질문과 논평 등을 게재할 수 있다.

9. 원고의 제출 양식

원고는 워드파일에서 글자크기 10으로 작성하고, 원고 전체에 대해서, 2줄 간격으로 저장하여 학회논문투고관리시스템에 올리기 메뉴를 이용하여 제출한다. 표, 그림 등은 출판에 적합한 용량의 파일로 제출하며, 최소 300 dpi에서 5 cm × 5 cm 이상의 화질 (500 dpi 권장)을 가져야 하고, 별도로 제출할 경우에는 게재 순서와 저자명을 파일명에 명확히 표기되게 하여야 한다.

* 원고 투고시에 반드시 cover letter (설명 편지)를 제출하여야 한다. 이 편지를 통해 저자는 원고에 대한 설명과 저작권의 양도, 이해관계, 및 동의의 획득에 관련된 필요한 사항이 있는 경우 그 내용을 기술하고 저자 모두 서명하여 원고와 함께 제출한다.

10. 원고의 게재 결정

제출된 원고는 편집위원회에서 위촉한 2명의 학계의 권위자에게 재고 의뢰 후, 게재 여부 및 수정의 필요성을 결정한다. 원고의 게재 결정 후 저자 요청 시 게재예정증명서를 발급할 수 있다.

11. 게재료

원고가 본 학회지에 게재된 경우 게재료는 저자가 부담함을 원칙으로 한다.

2010~2012 대한치과근관치료학회 임원진

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전 화 : 02-3410-2427

제11권 제2호
Vol. 11, No. 2, 2010

발 행 인 : 오태석 Publisher: Tae-Seok Oh

편 집 인 : 민경산 Editor in chief: Kyung-San Min

발 행 처 : 대한치과근관치료학회
The Journal of Korean Academy of Endodontics
서울특별시 강남구 일원동 50번지 삼성서울병원 치과진료부 內

전 화 : 02-3410-2427

표지사진 : Endodontic consideration in orthodontic treatment (p123)

The Journal of Korean Academy of Endodontics