# Interdisciplinary Approach to Endodontic Therapy for Uncooperative Children in a Dental School Environment

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*Abstract:* The aim of this study was to describe an interdisciplinary approach for endodontic therapy of behavior-challenging children and to report the efficacy of sedation techniques for these procedures. Sedation records of thirty-two patients who received root canal treatment were reviewed. Age at treatment in months, gender, year of treatment, tooth type, status of root maturation (open or closed apex), etiological factor(s), sedation protocol, and outcome were the variables analyzed. The collected information was entered into a computerized flowchart and the data analyzed using descriptive statistics. Midazolam in combination with meperidine or hydroxyzine were the most common protocols used (46 percent and 40 percent of the cases, respectively). Only two (6 percent) treatments were aborted due to uncontrolled behavior during sedation. We conclude that cooperation between pediatric dentists and endodontists is fundamental to achieving success when providing root canal treatment for uncooperative child patients.

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Advanced educational programs in endodontics educate dentists to provide challenging therapy with efficacy and accuracy by using sophisticated technology and a broad knowledge of the dental literature. Pediatric dentistry programs prepare dentists to provide treatment for uncooperative patients by focusing on pharmacologic and nonpharmacologic behavior management techniques. When providing restorative treatment for patients with mixed and young permanent dentitions, certain clinical scenarios may require interdisciplinary consultation and intervention such as following traumatic injuries and whenever permanent teeth require endodontic therapy.

Commonly, pediatric dentists refer patients to an endodontist for an expedient and predictable outcome for these injured or carious teeth. In general, the great majority of these referrals are cooperative patients who require no behavior management from the endodontist. Sometimes, the use of basic behavior management techniques such as tell, show, and do and nitrous oxide/oxygen inhalation analgesia suffices for treatment completion. Occasionally, because of increased anxiety, the use of a pharmacologic strategy becomes necessary. However, graduate endodontic curricula do not routinely include advanced behavior management training, and pediatric dentistry residency programs do not teach advanced endodontic therapies given the nature of their respective curricular objectives. Consequently, a clinical gap between the two departments exists, and a solution needs to be found.

A search of the pediatric dental and endodontic literature failed to reveal any reports of strategies for endodontic therapy of children with challenging behavior. The aim of our study was to describe an interdisciplinary approach for endodontic therapy of children with challenging behavior and to report the efficacy of conscious sedation techniques for these procedures.

## Methods

At the University of Florida College of Dentistry, a treatment protocol has been created to manage situations in which a pediatric patient requires root canal therapy under sedation on a permanent tooth. Primarily, a preoperative endodontic consultation by a faculty member or graduate resident is

obtained, and restorability issues are discussed. The decision on the type of sedative agent to be used is made after consultation and discussion with pediatric dental faculty members during weekly chart review meetings prior to sedation procedures. During those meetings, the patient's medical and behavioral histories are explored in depth, and legitimacy for the procedure is discussed. On the day of treatment, following the American Academy of Pediatric Dentistry (AAPD) guidelines for sedation,[1] patients are questioned for N.P.O. status (no food or liquids for eight hours prior to the procedure), medical history is reviewed, vital signs and informed consent are obtained, and sedation medication is administered by the pediatric dental resident. Dosage protocols for solo or combined sedative agents follow the existing guidelines for oral sedation in the Department of Pediatric Dentistry at the University of Florida College of Dentistry. The dosages are based on common regimens used in the pediatric dental literature and also on the manufacturer's guidelines (midazolam 0.5-0.75 mg/kg, chloral hydrate 25-75 mg/kg, meperidine 1-2 mg/kg, hydroxyzine 2-4 mg/kg, and ibuprofen 10 mg/kg).

Once the administered drugs have produced their desired effect, the patient is placed in a passive, medical immobilization device, which can be utilized according to the patient's behavior (Papoose Board, Olympic Medical Corp., Seattle, WA; wrapping pending behavior). A pulse oximeter is placed on the patient's finger or toe to measure oxygen saturation and pulse rate. Nitrous oxide (50 percent)/oxygen (50 percent) is administered throughout the treatment. For better patient control during local anesthesia administration, a mechanical mouth prop is placed, followed by the topical gel and local anesthesia. This is a critical stage of treatment, and verification of profound anesthesia must be obtained prior to beginning the operative phases. The role designated to the pediatric dental resident includes sedation monitoring, vital signs collection, and assurance of patient safety.

Single-visit root canal treatment is the desired goal for this difficult patient population. Other advantages for this protocol include reduced flare-up rate, good patient management, and acceptance.[2,3] In situations in which bleeding or suppuration cannot be controlled during root canal preparation, paramonochlorophenol and calcium hydroxide are placed as intracanal medication, and a second appointment is scheduled to finalize the treatment. The use of digital radiography and apex locator devices shortens treatment time. Cleaning and shaping procedures are performed using manual and rotary techniques, and obturation is conducted by warm vertical compaction of gutta-percha and sealer. In the case of immature roots (open apices), the use of biocompatible apical barriers is used to allow treatment completion in one visit, such as the application of CollaCote® (Sulzer Dental, Integra LifeSciences, Plainsboro, NJ) and demineralized bone.

For this study, after review and approval from the Institutional Review Board, records of patients who received root canal therapy on permanent teeth under sedation in the pediatric dental clinic at the University of Florida College of Dentistry between January 2000 and June 2005 were identified. The following variables were analyzed: age at treatment, gender, tooth type, status of root maturation (open or closed apex), etiological factor(s), sedation protocol, and clinical outcome. The collected information was entered into a computerized flowchart, and data were analyzed using descriptive statistics (Microsoft Excel, 2003).

# Results

Sedation records of thirty-two pediatric dental patients who received root canal treatment were reviewed. Data distribution is displayed in Table 1. The majority of patients (72 percent) were between eight and eleven years old with gender being equally distributed. Regardless of age, mandibular first permanent molars were the most treated teeth (72 percent), followed by maxillary first permanent molars and maxillary central incisors. Carious pulp exposures were the main reason for treatment (twenty-eight cases), followed by traumatic injuries (four cases). Consistent with tooth development in the eight-to-nine-year-old group, 38 percent of the teeth had immature roots and were treated according to the open apex protocol.

Table 2 displays the conscious sedation drugs and dosages that were used in the study. Midazolam, in combination with meperidine or hydroxyzine, was the most common protocol used (46 percent and 40 percent of the cases, respectively). Other combinations included the following: 1) midazolam with ibuprofen; 2) chloral hydrate-meperidine and hydroxyzine; and 3) meperidine with hydroxyzine. Treatment outcome was rated as "completed" or "aborted" based on the endodontic residents' progress notes. Out of thirty-two cases, only two (6 percent) treatments were aborted due to uncontrolled behavior

**Table 1. Data distribution**

| Age (years) | Gender | | Tooth Type | | | Reason for Treatment | | Root Development | |
|---|---|---|---|---|---|---|---|---|---|
| | Male | Female | Mx1M | Md1M | MxI | Decay | Trauma | Closed | Open |
| 6-7 | 3 | 5 | 1 | 6 | 1 | 7 | 1 | 0 | 8 |
| 8-9 | 8 | 5 | 1 | 10 | 2 | 11 | 2 | 8 | 5 |
| 10-11 | 5 | 5 | 3 | 6 | 1 | 9 | 1 | 10 | 0 |
| >12 | 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 0 |

Mx1M: maxillary first permanent molar; Md1M: mandibular first permanent molar; MxI: maxillary permanent incisor

and inability to safely provide treatment during sedation involving the midazolam-meperidine protocol. No adverse effects including all drug protocols were recorded. IRM® (Dentsply International, Milford, DE) was the immediate restoration in 31 percent of the cases, followed by composite resin restorations (29 percent), amalgam restorations (22 percent), and stainless steel crowns (18 percent).

# Discussion

In this retrospective review of patients' records, treatment was performed for an older group of children in which the majority were eight to eleven years of age. Little information is available on the use of sedative agents for the mixed dentition aged population. A Swedish study reported a 63 percent complete success and a 30 percent moderate success rate for midazolam alone when performing restorations and extractions for this age group.[4] In a recent study on autistic patients, the effectiveness of oral administration of diazepam and midazolam was assessed for dental treatment.[5] Results showed that midazolam was more effective than diazepam, but only at the first twenty-minute interval. For the remaining time, there was no difference between the two drugs. A more definitive conclusion in favor of the usage of midazolam instead of diazepam could possibly come from a prospective randomized clinical trial testing the two regimens during endodontic sedations. Overall, regardless of the drug combinations used in this study, no adverse effects were recorded, reinforcing the known safety record for these sedation protocols.

**Table 2. Summary of sedation protocols**

| Medication | Number of Cases |
|---|---|
| Midazolam 0.5-0.75mg/kg<br>Ibuprofen 10mg/kg | 2 |
| Midazolam 0.5-0.75mg/kg<br>Meperidine 1mg/kg | 15 |
| Midazolam 0.5-0.75mg/kg<br>Hydroxyzine 2mg/kg | 13 |
| Chloral Hydrate 25mg/kg<br>Meperidine 1mg/kg<br>Hydroxyzine 2mg/kg | 1 |
| Hydroxyzine 2-4mg/kg | 1 |

Midazolam, in combination with other sedative agents, was used in the majority of the cases included in this study. Explanation for such wide use may be easily justified by its high safety record.[6-9] As a short-acting benzodiazepine, midazolam has a rapid onset and a short duration effect and is generally not recommended for long restorative procedures such as root canal treatment. Examples of reported undesired effects when used alone include increased patient agitation, short working time, and movement with crying.[6,8] The rationale for the combined use of midazolam with meperidine and midazolam with hydroxyzine is that it provides additional working time and less disruptive behavior. This was previously achieved with both regimens when dental treatment was provided to young patients.[6-9] When ibuprofen was added to midazolam, it served as a sweetener vehicle and as a postoperative pain reliever.

The triple combination of meperidine, chloral hydrate, and hydroxizyne has been previously reported in pediatric dentistry,[10,11] though in a much younger population than ours. Although no clinical studies for an older age group have been reported, this combination was effectively used in this study.

Midazolam and meperidine are potential CNS depressants and may cause respiratory depression. Fortunately, if detected early by close monitoring, this adverse effect can be completely reversed by utilization of flumazenil, a reversal agent for ben-

zodiazepines, and/or naloxone, a reversal agent for narcotics such as meperidine. Both drugs and a series of emergency medications including oxygen are essential parts of the sedation armamentarium. Certification on advanced cardiac life support training (ACLS) and/or pediatric advanced life support training (PALS) are prerequisites for anyone performing treatment under conscious and deep sedation.[1]

It is the recommendation of the Departments of Endodontics and Pediatric Dentistry at the University of Florida College of Dentistry whenever possible not to place a temporary restoration such as IRM® after completion of the root canal therapy. This is especially important when interacting with a low compliant population as mostly seen in academic institutions.[12] Ultimately, coronal coverage with a stainless steel crown for posterior young permanent teeth is recommended for this age group of patients due to its well-known longevity, durability, and increased fracture resistance.[13]

In summary, the results of this study demonstrated a successful interdisciplinary collaboration to address behavior-challenging patients that pediatric dentists and endodontists might encounter. An effective working relationship between endodontic and pediatric dentistry departments is critical for procedural success. Since no data on how private practitioners manage similar situations are available, we suggest both disciplines should consider curricular revision for their graduate programs. Incorporation of conscious sedation and endodontic techniques in both advanced training curricula will better prepare professionals for challenging cases in their private practices.

# Conclusions

Our retrospective review of the sedation records for thirty-two cases indicated that midazolam with meperidine and midazolam with hydroxyzine were safe and suitable drug regimens for endodontic procedures for children and young adult patients. In addition, cooperation between pediatric dentists and endodontists is fundamental to achieve treatment success when providing root canal treatment for uncooperative patients. A protocol is recommended for use in a dental school environment.

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