

Integrated Endodontic and Oral Surgical Management in Autism Spectrum Disorder: A Clinical and Radiographic Outcome Study

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ABSTRACT:

Background: Children and adolescents with autism spectrum disorder (ASD) experience a disproportionate burden of dental disease, frequently requiring complex restorative, endodontic, and oral surgical interventions. Behavioural and sensory characteristics of ASD complicate in-office dental care and often necessitate adjunctive techniques such as sensory adaptation, sedation, or general anaesthesia, yet integrated outcome data on combined endodontic and surgical management remain limited.

Objective: To evaluate the clinical and radiographic outcomes of integrated non-surgical endodontic and oral surgical treatment in patients with ASD compared with neurotypical controls, and to assess associated treatment characteristics, complications, and tooth survival.

Methods: A prospective comparative clinical and radiographic study was conducted on 60 patients (30 with confirmed ASD diagnosis as per Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria and 30 age- and sex-matched neurotypical controls) aged 6 to 18 years presenting with pulpal pathology and/or indication for surgical extraction. Treatment was performed using a tiered behavioural-pharmacological protocol involving sensory-adapted dental environment, conscious sedation, or general anaesthesia, as required. Pre- and postoperative periapical radiographs were scored using the Periapical Index (PAI). Patients were reviewed at 6 and 12 months for clinical signs, radiographic healing, tooth survival, and complications.

Results: Endodontic success was achieved in 89.5% of teeth in the ASD group compared with 93.5% in controls ($p > 0.05$). Tooth survival at 12 months was 96.6% in the ASD group and 98.4% in controls. Surgical extraction sites healed

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uneventfully in 90.5% of ASD patients. Postoperative behavioural disturbances were reported in 13.3% of ASD patients but in none of the controls. General anaesthesia was used in 80% of ASD treatments versus 13.3% of controls.

Conclusion: Integrated endodontic and oral surgical management is feasible and produces clinical and radiographic outcomes in ASD patients comparable to those in neurotypical peers when delivered through a structured, behaviourally adapted protocol. Postoperative behavioural disturbances and the high reliance on general anaesthesia warrant pre-treatment counselling and individualised care pathways.

Keywords: Autism spectrum disorder, Dental management, Endodontic treatment, General anaesthesia, Oral surgery, Periapical Index, Special health care needs.

Introduction

Autism spectrum disorder (ASD) is a heterogeneous neurodevelopmental condition characterised by persistent deficits in social communication and interaction, alongside restricted, repetitive patterns of behaviour, interests, or activities. The reported global prevalence of ASD has risen substantially over the past two decades, with current estimates suggesting that approximately one in 100 children worldwide is affected [1]. As more affected individuals reach adolescence and adulthood, the demand for comprehensive dental services tailored to their needs continues to grow.

Children and adolescents with ASD often experience considerable challenges in maintaining oral health. Sensory hypersensitivity, communication barriers, restrictive food preferences, repetitive behaviours, bruxism, and dependence on caregivers for oral hygiene contribute to a higher risk of caries, periodontal disease, and traumatic dental injuries [2, 3]. Although findings vary across populations, several systematic reviews have reported elevated pooled prevalence rates of dental caries (60–67%) and periodontal disease (60–70%) among individuals with ASD compared with neurotypical peers [4,5].

These oral health disparities translate into a higher demand for restorative and surgical care. Many patients with ASD present late, with extensive carious destruction, pulpal involvement, or non-restorable teeth requiring root canal therapy or extraction [6, 7]. The clinical management of such patients is complicated by dental anxiety, uncooperative behaviour, and aversion to

instruments, light, and sound, which collectively reduce the feasibility of conventional in-office dentistry [8, 9].

To address these challenges, a tiered approach to behavioural guidance has been advocated. This includes sensory-adapted dental environments (SADE), visual pedagogy, video modelling, parental presence, conscious sedation, and, where indicated, dental treatment under general anaesthesia [10, 11, 12]. Sensory adaptation involves the modification of lighting, sound, and tactile stimuli within the operatory and has been shown to reduce physiological and behavioural stress markers in children with ASD undergoing routine oral care [13, 14]. When such measures are insufficient, conscious sedation and general anaesthesia provide an alternative pathway to deliver complex care safely and efficiently [15, 16].

Endodontic therapy in patients with ASD presents particular challenges. The need for prolonged chair time, isolation with rubber dam, repeated radiographs, and meticulous canal disinfection can be difficult in uncooperative patients. Despite these challenges, recent observational studies have reported high tooth survival and favourable periapical healing for non-surgical root canal treatment performed under general anaesthesia in patients with special health care needs, including ASD [17, 18]. Similarly, oral surgical procedures, particularly extractions of carious or non-restorable teeth, are commonly performed under general anaesthesia in this population, with generally favourable outcomes but a notable risk of postoperative behavioural change [19, 20].

The present study was therefore designed to evaluate the clinical and radiographic outcomes of integrated non-surgical endodontic and oral surgical management in patients with ASD compared with age- and sex-matched neurotypical controls. The findings are intended to inform evidence-based protocols and to support the development of integrated care pathways for this vulnerable population.

Methodology

This prospective comparative clinical and radiographic study was conducted in the Departments of Conservative Dentistry and Endodontics and Oral and Maxillofacial Surgery in collaboration with the Department of Oral Medicine and Radiology over a period of 18 months. Ethical approval was obtained from the Institutional Ethics Committee, and written informed consent was obtained from the parents or legal guardians of all participants prior to enrolment, in accordance with the Declaration of Helsinki.

Participants and grouping

A total of 60 pediatric and adolescent patients aged 6 to 18 years were enrolled and allocated into two groups of 30 each. Group I consisted of patients with a confirmed diagnosis of ASD, established by a pediatrician or developmental specialist according to the Diagnostic and Statistical Manual of Mental Disorders, Fifth Edition (DSM-5) criteria. Group II comprised age- and sex-matched neurotypical controls who required comparable endodontic or oral surgical care. Patients were eligible if they presented with at least one tooth requiring non-surgical root canal treatment due to pulpal or periapical pathology and/or surgical extraction of a non-restorable tooth. Patients with uncontrolled systemic disease, contraindications to general anaesthesia, ongoing antibiotic therapy, or recent endodontic intervention were excluded from the study.

Pre-treatment evaluation and behavioural assessment

All participants underwent a comprehensive medical and dental history, intra-oral examination, and standardised periapical radiographic

assessment. Cooperation was scored using the Frankl Behaviour Rating Scale, and parental reports of sensory sensitivities and previous dental experiences were recorded. A tiered behavioural management plan was formulated for each patient based on cognitive level, communication ability, and parental preference, ranging from sensory-adapted in-office care to conscious sedation or dental treatment under general anaesthesia.

Treatment protocol

Patients managed in the dental office received care in SADE with reduced ambient light, noise-cancelling headphones, weighted blankets, and visual schedules. Patients unable to cooperate despite these adaptations underwent conscious sedation using oral midazolam combined with nitrous oxide and oxygen inhalation. Where comprehensive treatment under sedation was not feasible, dental care was delivered under general anaesthesia following a standardised hospital protocol with nasotracheal intubation.

Non-surgical root canal treatment was performed in single or multiple visits depending on patient cooperation and treatment setting. Mechanical preparation was completed using rotary nickel-titanium files with passive ultrasonic activation of sodium hypochlorite irrigation. Obturation was carried out using gutta-percha and a calcium silicate-based sealer. Surgical extraction was performed using standard atraumatic principles with primary closure where indicated. All teeth receiving endodontic treatment received a definitive coronal restoration, with stainless steel crowns used for compromised primary or young permanent molars.

Outcome assessment

Pre-treatment and follow-up periapical radiographs were independently scored by two calibrated examiners using the Periapical Index (PAI). Endodontic success was defined as the absence of clinical signs and symptoms together with reduction or resolution of periapical radiolucency at 12 months ($\text{PAI} \leq 2$). Surgical healing was assessed clinically at 7 days, 1 month, and 12 months. Tooth survival was defined as the retention of the treated tooth in the arch at 12

months without clinical or radiographic indication for further intervention. Adverse events, including postoperative pain, behavioural disturbance, delayed healing, and reintervention, were recorded throughout the follow-up period.

Statistical analysis

Data were entered into a spreadsheet and analysed using standard statistical software. Continuous variables were compared using the independent t-test, while categorical variables were analysed using chi-square or Fisher's exact tests. Inter-examiner agreement for PAI scoring was assessed using Cohen's kappa. A p-value of less than 0.05 was considered statistically significant.

Results

All 60 enrolled patients completed the 12-month follow-up. The baseline demographic characteristics mean Decayed, Missed and Filled teeth (DMFT/dmft) scores, and treatment settings are summarised in Table 1. Although age and gender distribution were broadly comparable between groups, the ASD group exhibited a significantly higher mean DMFT/dmft (6.8 ± 2.4) than the control group (4.1 ± 1.9), reflecting the higher disease burden previously reported in this population. General anaesthesia was used in 80% of ASD patients but in only 13.3% of controls, reflecting the differing behavioural profiles of the two groups.

Table 1: Baseline demographic characteristics and treatment settings

Parameter	ASD Group (n=30)	Control Group (n=30)
Mean Age (years)	11.4 ± 3.2	11.7 ± 3.0
Gender (M/F)	22 / 8	18 / 12
Mean DMFT/dmft	6.8 ± 2.4	4.1 ± 1.9
Treatment Setting	GA: 24 / Sedation: 6	GA: 4 / Conventional: 26

The distribution of dental procedures performed across the two groups is shown in Table 2. Both groups received a comparable number of non-surgical root canal treatments. However, surgical extractions were almost twice as frequent in the ASD group, reflecting the higher proportion of

non-restorable teeth at presentation. Pulp therapy and stainless steel crown placement were also more common in ASD patients, consistent with a more aggressive treatment philosophy aimed at reducing the need for repeat interventions.⁴

Table 2: Distribution of endodontic and surgical procedures performed

Procedure	ASD Group (n)	Control Group (n)
Non-surgical RCT	38	31
Surgical Extraction	21	9
Pulpotomy / Pulpectomy	12	8
Stainless Steel Crown	18	11

Mean PAI scores for endodontically treated teeth at baseline, 6 months, and 12 months are presented in Table 3. Both groups demonstrated a

progressive reduction in mean PAI scores, indicating periapical healing. While final mean PAI scores were marginally higher in the ASD group,

the difference was not statistically significant ($p > 0.05$). Inter-examiner agreement for PAI scoring

Table 3: Mean PAI scores at baseline, 6 months, and 12 months

Time Point	ASD Group Mean PAI	Control Group Mean PAI
Pre-treatment	3.4 ± 0.7	3.2 ± 0.6
6 months	2.1 ± 0.5	1.8 ± 0.4
12 months	1.5 ± 0.4	1.3 ± 0.3

Clinical and radiographic outcomes at 12 months are summarised in Table 4. Endodontic success was achieved in 89.5% of treated teeth in the ASD group, compared with 93.5% in the control group. Surgical extraction sites healed uneventfully in 90.5% of ASD patients and in all controls. Tooth survival at 12 months was 96.6% in the ASD group and 98.4% in the control group, with no statistically significant difference between the groups.

Table 4: Clinical and radiographic outcomes at 12 months

Outcome	ASD Group (%)	Control Group (%)
Endodontic Success	89.5	93.5
Surgical Healing (uneventful)	90.5	100.0
Tooth Survival at 12 months	96.6	98.4
Postoperative Complications	13.3	3.3

Adverse events are summarised in Table 5. Postoperative behavioural disturbance, including transient regression, irritability, sleep disturbance, and reduced social engagement during the first postoperative week, was reported in 4 ASD patients (13.3%) but in none of the controls. Delayed wound healing and prolonged postoperative pain occurred at low frequencies and was comparable between groups. No major anaesthetic complications, infections, or hospital readmissions were recorded.

Table 5: Adverse events recorded during the 12-month follow-up period

Adverse Event	ASD Group (n)	Control Group (n)
Postoperative behavioral disturbance	4	0
Delayed wound healing	2	1
Postoperative pain (>48 h)	3	1
None	21	28

Overall, the integrated protocol provided high tooth survival and acceptable endodontic and surgical outcomes in ASD patients, with adverse events largely limited to transient postoperative behavioural changes.

Discussion

The present study evaluated the clinical and radiographic outcomes of an integrated endodontic and oral surgical management protocol in paediatric and adolescent patients with ASD, compared with neurotypical controls. The principal finding is that, when care is delivered through a tiered behavioural and pharmacological pathway, ASD patients can achieve endodontic success rates and tooth survival comparable to those of neurotypical peers, although at the cost of greater reliance on general anaesthesia and a higher incidence of postoperative behavioural disturbance.

The higher mean DMFT/dmft observed in the ASD group is consistent with prior reports. Similar findings were subsequently described by Jaber et al. (2011) [3], who documented elevated caries prevalence, poor oral hygiene, and considerable unmet treatment needs in autistic children when compared with non-autistic peers. Systematic reviews have since confirmed substantial pooled prevalence rates of caries and periodontal disease in this population, while also highlighting the heterogeneity in reported outcomes. The increased disease burden observed at baseline in our ASD cohort therefore aligns closely with the existing literature and reinforces the need for early preventive engagement.

A high proportion of ASD patients in our study required dental treatment under general anaesthesia, in contrast with the predominantly conventional in-office care delivered to controls. This pattern mirrors that reported by Gupta A et al. (2024) [5], who documented extensive treatment needs and the necessity dental care in individuals [5]. Lim and Borromeo (2017) similarly emphasised that general anaesthesia is often the only practical option for delivering complex dental care to adult patients with special needs [21]. More recent retrospective analyses have shown that ASD patients undergoing dental treatment under general anaesthesia tend to require longer treatment durations and a greater number of procedures than neurotypical peers, even when both groups present with cooperation difficulties [22]. Our findings are consistent with these observations and reinforce

the importance of careful pre-anaesthetic assessment and multidisciplinary planning.

Endodontic outcomes in our ASD cohort were favourable, with a 12-month success rate of 89.5% and a tooth survival rate of 96.6%. These figures are broadly consistent with the observational data reported by Sami W and colleagues, who described a 98.7% survival rate for non-surgical root canal treatment, performed under general anaesthesia in patients with special health care needs, of whom 39.4% had ASD or attention deficit hyperactivity disorder [23]. A subsequent systematic review of single-visit endodontic treatment under general anaesthesia in adolescent and adult patients with special needs likewise reported acceptable short-term outcomes, while highlighting the heterogeneity of available evidence [24]. Although our success rate was marginally lower than that reported in neurotypical populations treated under standard conditions, this likely reflects the operative challenges associated with comprehensive treatment under general anaesthesia, including limited working time and the need for definitive obturation in a single visit.

Sensory adaptation played a central role in our protocol for patients amenable to in-office care. Cermak and co-workers were among the first to provide robust evidence that SADE reduce physiological anxiety, behavioural distress, and sensory discomfort during oral prophylaxis in children with ASD [8]. Subsequent randomized and observational studies have confirmed the value of sensory adaptation, visual aids, and video modelling for improving cooperation during routine dental care [9, 13, 14]. Although the role of sensory adaptation in complex restorative or surgical procedures is less well established, our experience suggests that it can serve as a useful first step in a stepped-care pathway, enabling some patients to avoid sedation or general anaesthesia for less invasive components of their treatment plan.

Conscious sedation provided an intermediate management option for selected patients in our cohort. The narrative review by Vallogini G and colleagues highlighted both the potential utility and the limited evidence base for conscious sedation in

autistic children, identifying only a small number of original studies addressing this question [15].

The integration of sensory adaptation and conscious sedation within a single tiered protocol, as described here, may help to expand the proportion of patients who can be managed without recourse to general anaesthesia and warrants further evaluation.

A particularly noteworthy finding of the present study was the occurrence of postoperative behavioural disturbance in 13.3% of ASD patients, manifested as transient irritability, sleep disturbance, and reduced social engagement. This observation is in keeping with the case reports of Mattonet al (2017), who described behavioural regression in two patients with ASD and ADHD following oral surgery under general anaesthesia [10]. A subsequent prospective cohort study by Lai and colleagues similarly identified short- and longer-term behavioural changes in autistic children following dental treatment under general anaesthesia [14]. Although the precise mechanism remains uncertain, contributing factors may include disruption of routine, sensory overload, postoperative discomfort, and individual susceptibility to anaesthetic agents. Caregivers should be specifically counselled regarding the possibility of these transient changes, and structured postoperative behavioural support should be considered. The behavioural and pharmacological strategies employed in our study are consistent with the contemporary recommendations of Delliet al. (2013), who emphasized individualization of behavioural guidance based on each patient's profile [4]. Taken together, these contributions support a coordinated approach in which behavioural, sensory, pharmacological, and surgical strategies are deployed in a complementary rather than competing manner [25].

Limitations

Our study has several limitations. First, although the sample size was adequate to detect major differences in outcomes, it may have been insufficient to identify smaller but clinically

meaningful effects. Second, the 12-month follow-up captures short- to medium-term outcomes only, and longer-term tooth survival and recurrence of caries warrant further evaluation. Third, the study was conducted at a single centre with established expertise in special needs dentistry, which may limit generalisability to settings with fewer resources. Finally, the heterogeneity within the ASD spectrum, in terms of cognitive ability, communication, and sensory profile, was not exhaustively analysed, and future studies with larger samples may permit more granular subgroup analyses.

Despite these limitations, the present study contributes to a growing body of evidence indicating that, with appropriate behavioural adaptation and judicious use of pharmacological adjuncts, integrated endodontic and oral surgical care can be delivered safely and effectively to patients with ASD. These findings support the development of structured care pathways and underscore the importance of multidisciplinary collaboration among paediatric dentists, endodontists, oral surgeons, paediatricians, anaesthetists, and behavioural specialists.

Conclusion

Within the limitations of this study, integrated non-surgical endodontic and oral surgical management produced clinical and radiographic outcomes in patients with ASD that were broadly comparable to those of age- and sex-matched neurotypical controls. Endodontic success rates approached 90%, tooth survival exceeded 96% at 12 months, and surgical extraction sites healed uneventfully in the majority of cases. The principal differences observed were a markedly higher reliance on general anaesthesia and a small but clinically relevant incidence of transient postoperative behavioural disturbance in the ASD cohort. A tiered, individualised pathway combining sensory adaptation, conscious sedation, and general anaesthesia, supported by careful caregiver counselling and structured follow-up, appears to be an effective strategy for the comprehensive dental management of patients with ASD.

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