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Root Resection: A Contemporary Perspective on Tooth Preservation

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ABSTRACT:
Root resection, also known as root amputation, is a surgical procedure aimed at preserving a compromised tooth by removing one or more roots while retaining the healthy portions of the tooth structure. This procedure has gained significance in modern dentistry as it offers an alternative to extraction, enabling the maintenance of natural dentition and occlusal stability. Outcome of root resection can vary depending on various factors such as the tooth involved, the extent of the pathology, and the patient's overall oral health. However, its success relies on appropriate case selection, meticulous execution, and comprehensive follow-up care. Continued research and advancements in techniques and materials will further enhance the outcomes and broaden the applicability of root resection in contemporary dental practice.

KEYWORDS: Radectomy, Root amputation, Apicoectomy, Root resection

INTRODUCTION:

Root resection is the process by which one or more of the roots of teeth are removed at the level of furcation while leaving the crown and remaining roots in function.[1] This procedure, also known as radectomy, root amputation, or apicoectomy, has been used for decades as a treatment option for molars with furcation involvement, especially when other conservative treatment methods are not viable. Root resection procedures have been widely utilized to preserve molars under various clinical conditions that affect multi-rooted teeth, providing an alternative to extraction in cases of advanced periodontal disease.[2,3,4]

Studies have shown that furcation involvement is more common in maxillary molars than in mandibular molars, with the incidence of distal furcation involvement being higher compared to mesial furcation in maxillary molars.[5] This may explain the high percentage (45.5%) of root resections involving the disto-buccal root in maxillary molars.[6]

According to Amen[7], root amputation is particularly beneficial in isolated areas of extensive periodontal destruction where the likelihood of achieving adequate new attachment is low, and where resective techniques are necessary to remove the defect without compromising the periodontal support of adjacent

teeth. Advanced furcation pathology for whatever reason not amenable to reattachment attempts maybe resolved through hemisection, bisection or root amputation where one or more roots remain periodontally salvagable. In such cases, endodontic treatment prior to resection and additional periodontal procedures are often recommended to optimize the long-term outcomes.

Root resection of multi-rooted teeth enables the preservation of teeth as bridge abutments, clasp retainers, conical crowns, and other dental attachments, which can serve as "biological stops" under removable partial dentures. Several studies have reported favorable outcomes following root resection, though most have documented these outcomes after varying post-operative periods, limiting the ability to draw definitive conclusions. [8,9,10] More reliable results could be obtained if all cases were investigated and compared after post-operative periods of equal duration. Long-term follow-ups provide more reliable data, offering valuable insights into the effectiveness of different treatment modalities.[11]

Root-resective procedures aim to manage furcation-involved teeth by eliminating plaque-retentive niches and establishing a dental morphology that facilitates effective self-performed plaque control.[12] These procedures can be classified into root separation (RS), involving sectioning of the root complex while maintaining all roots, or root separation and resection (RSR), which includes the removal of a root with or without the associated portion of the crown.[13]

The long-term success of root-resective treatments depends upon meticulous periodontal, endodontic, and restorative therapies, as well as a high level of patient motivation and compliance.[14]

Minsk and Polson[15] suggested that root resection can be a valuable procedure when the tooth in question has a very high strategic value or when other therapeutic approaches are not feasible. Root resection can be safely performed on teeth located near anatomical landmarks, such as the maxillary sinus and the inferior alveolar canal. Additionally, molars that have undergone root resection can be utilized for alveolar bone augmentation through orthodontic movement.[16]

Several factors need to be considered while determining which root should be retained during a root resection. These factors include the amount of supporting tissue around the roots, the root and root canal anatomy in relation to endodontic treatment, the periapical condition, and the mobility of each separated root.[9]

Molars with minimal supporting bone or those with deep osseous craters in the furcation area are generally poor candidates for root-resection therapy due to the high risk of recurrent periodontal breakdown following the procedure. However, there is limited evidence available that identifies the specific factors influencing the survival rate of resected molars.[16]

INDICATIONS AND CONTRAINDICATIONS:

Indications:

1. A tooth that serves as an abutment for fixed or removable dentures.[13]
2. A tooth with sufficient periodontal attachment to maintain its function.
3. Situations where predicting the treatment outcome is difficult, or when no cost-effective alternative treatments are available.
4. According to Choi et al., root resection is also suitable for patients with excellent oral hygiene and low caries activity. [17]
5. Severely furcation-involved maxillary molars with preserved pulp vitality (Jepsen et al., 2020).

Contraindications:

1. An unfavorable crown-to-root ratio.

2. Inadequate bone support.
3. Fused roots.
4. Apically positioned furcation.
5. Insufficient tooth structure for restoration.
6. Poor root form of the remaining root.
7. Poor oral hygiene.

DIAGNOSTIC CONSIDERATIONS FOR ROOT RESECTION:

Several diagnostic factors must be evaluated to determine if a tooth is a suitable candidate for root resection:

1. Assessment of Endodontic and Periapical Status:

- Radiographic evaluation (periapical and/or panoramic) should be performed at key intervals:

1. Before the root resection procedure.
2. Immediately following root resection.
3. After completing prosthetic rehabilitation.
4. At the last dental check-up.

- The periapical status should be assessed on the most recent radiograph using the Periapical Index (PAI). This index assesses:

1. Normal periapical structure.
2. Minor changes in bone structure.
3. Changes in bone structure with some mineral loss.
4. Periodontitis with a well-defined radiolucent area.
5. Severe periodontitis with exacerbating features. [18, 19]

2. Assessment of the Periodontal Condition:

- At the most recent examination, the periodontal status of the remaining molars should be thoroughly evaluated. Probing pocket depths should be measured at the mesial, distal, buccal, and lingual surfaces of each tooth using a calibrated periodontal probe (UNC 15).
- Tooth mobility should also be assessed and classified as follows:

1. No detectable mobility.
2. Slightly palpable mobility.
3. Visible mobility.
4. Mobility on application of lip or tongue pressure and/or in an axial direction.[20]

SURGICAL PROCEDURE:

The surgical procedure for root resection begins with achieving adequate local anesthesia to ensure patient comfort. A thorough clinical and radiographic evaluation is performed to confirm the surgical site. A minimally invasive approach is preferred to preserve soft tissue and bone structures.

An intrasulcular incision is made, followed by the careful elevation of a full-thickness mucoperiosteal flap to expose the affected root and surrounding structures. Flap design should allow for adequate access while preserving the interdental papilla whenever possible.

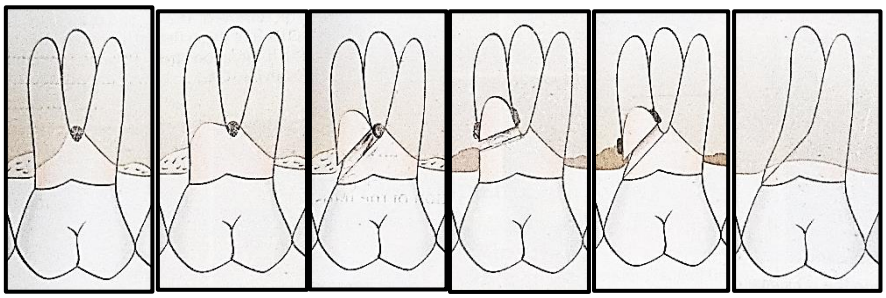
Using piezoelectric surgical instruments or high-speed rotary burs with continuous sterile saline irrigation, the root is sectioned along the predetermined resection line. The sectioning is performed with precision to avoid unnecessary removal of sound tooth structure and to minimize trauma to the remaining roots.

The resected root is gently luxated and removed with fine periotomes or elevators, ensuring minimal disturbance to the surrounding bone. After extraction, thorough debridement of the socket and furcation area is carried out using curettes to remove any granulation tissue and to ensure a clean environment conducive to healing.

Root-end conditioning involves smoothening the resected surfaces using diamond burs to eliminate sharp edges and create favorable contours that facilitate plaque control. If the pulp is exposed, vital pulp therapy techniques, such as the application of biocompatible materials like calcium silicate-based cements, are employed to maintain pulp vitality.[21]

The surgical site is then irrigated with sterile saline, and the flap is repositioned and sutured using non-resorbable or resorbable sutures, depending on the clinical situation. Postoperative care includes prescribing analgesics, providing oral hygiene instructions, and scheduling follow-up visits for suture removal and evaluation of healing.

SCHEMATIC PRESENTATION OF ROOT RESECTION PROCEDURE



(a) (b) (c) (d) (e) (f)

Figure 1: Distobuccal root resection of a Maxillary first molar (a) Preoperative bony contours with Grade II buccal furcation and a crater between the first and second molar (b) Removal of bone from the facial of the distobuccal root and exposure of the furcation for instrumentation (c) Oblique section that separates the distal root from the mesial and palatal roots of the molar (d) More horizontal section that may be used on a vital root amputation as it exposes less of the pulp of the tooth (e) Areas of application of instruments to elevate the sectioned root (f) Final contours of the resection

*(**Image courtesy:** Chowdhary Z, Mohan R. Furcation involvement: Still a dilemma. Indian Journal of Multidisciplinary Dentistry. 2017;7(1).)*

Advantages of Root Resection:

1. More predictable results in reducing pockets and inflammation.
2. Reduces the possibility of future bone support loss, and therefore tooth loss.
3. Facilitates the maintenance of proper oral hygiene.
4. Improves the ability to access and treat areas with inflammation and pockets, aiding in the eradication of diseased tissue.
5. Root amputation can be a valuable treatment option for preserving teeth with high strategic value or when anatomical factors make implant placement unfeasible.[22]

Disadvantages of Root Resection:

1. This procedure is technique sensitive and requires extensive surgical experience and skill.
2. The cost of combined endodontic, periodontal, and prosthetic therapy is higher compared to extraction

and implant placement.

3. There is a risk that procedure may ultimately fail, resulting in the need for extraction.[23]
4. Root amputation can increase tooth mobility, which may lead to further loss of attachment.[24]

DISCUSSION:

Root-resection therapy allows for the conversion of furcation-involved molars into non-furcated, single-root teeth, creating a more favorable environment for oral hygiene maintenance by both patients and clinicians. The prognosis for root resection has been extensively documented, with varied outcomes. A study by Jepsen et al. (2020)[21] reported a survival rate of over 90% for root-resected molars, while another study by Buhler (1988)[25] found that approximately 30% of resected molars fail within a 10-year period. Comparisons have also been made between the prognosis of root-resection therapy and implant therapy. Kinsel et al.[26] reviewed the outcomes of root-resection therapy compared to single implants in the molar regions. They found a 15.9% failure rate for root-resection therapy, whereas single implants had a significantly lower failure rate of 3.6%. The study highlighted that the long-term success of root-resection therapy is often dependent on the availability of high-level expertise across all relevant dental disciplines. Majzoub and Kon[1] reported that 86% of disto-buccal root-resected maxillary first molars experienced a violation of the biologic width, with only 6% of resected molars having a topography that was easily manageable for periodontal maintenance and prosthetic reconstruction. When performing root resections on maxillary molars, it is essential to consider furcal concavities to create a favorable environment for oral hygiene. After resection, regular maintenance, including subgingival instrumentation, may be necessary to prevent periodontal disease.[27]

Molars that underwent root resection due to periodontal issues had a higher survival rate than those resected for non-periodontal reasons. Root-resection therapy in molars with periodontal problems is based on the specific periodontal pathology and can result in a favorable prognosis.[28]

Root-resection therapy is effective in removing periodontal bacteria and calculus deposits, as well as unfavorable anatomical features that could serve as future reservoirs for bacteria. It can also resolve bone defects, such as hemiseptal and deep infrabony defects, through healing after the removal of the affected roots, achieving a positive architectural outcome. Thus, root-resection therapy remains a viable treatment option for saving periodontally compromised molars.[28]

The survival data for teeth following resective treatment vary significantly. Some authors have reported excellent retention rates for resected molars over periods of 3 to 5 years. However, longitudinal studies of 10 years have yielded mixed results.[28] The complexity of cases and varying treatment conditions may contribute to the variability in clinical outcomes. Due to the inconsistent survival data and the increasing popularity of dental implants, root-resective therapy has become less favored among many clinicians.[12]

Molars that have undergone disto-buccal or palatal root resection in the maxilla tend to have higher early failure rates. In the mandible, molars that underwent disto-lingual root resection or resection of both distal roots in three-rooted molars showed higher failure rates compared to other teeth. Additionally, mandibular molars with distal or mesial root resections experienced more early periodontal failures than bicuspidizations. Mandibular molars with distal root resections were more prone to root fractures than other molars in the mandible.[27]

CONCLUSION:

Root resection is a viable treatment option for preserving molars with furcation involvement, employing

a multidisciplinary approach. Success in this procedure hinges on careful case selection and meticulous treatment planning. For molars affected by furcation involvement, root-resection therapy remains a valuable choice. However, root removal performed for non-periodontal reasons tends to have poorer outcomes compared to root resection aimed at treating periodontal issues.

When managing periodontally compromised molars, it is crucial that the remaining roots retain at least 50% of their bone support at the time of root removal. Given the high incidence of recurrent periodontal problems around resected molars, ongoing supportive periodontal care is essential. Additionally, a careful prosthetic design is necessary to prevent biomechanically induced fractures of resected molars. To further validate these findings, additional prospective studies are needed.

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