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Pain and coronal-radicular reconstruction: Care-related factors

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Abstract

Corono-radicular reconstruction is a restoration that uses an intra-root anchor to restore a decayed tooth. It is a very delicate treatment, with the risk of complications that are often painful. Pain is one of the most frequent reasons for consultation in odontostomatology, and pain associated with fixed prosthetic restorations accounts for between 18.4% and 63% of cases. The aim of this study was to determine its frequency, describe its characteristics and identify its risk factors.

It is a prospective, descriptive, cross-sectional study, carried out from March to November 2023 on patients attending a consultation at a PZaGa Androva University Hospital and a private dental practice in Tanambao Ambalavato Mahajanga. Patients aged 18 and over with post-corono-radicular reconstruction pain were included in the study, while uncooperative and mentally handicapped patients were excluded.

Thirty-five patients presented with post-corono-radicular reconstruction pain during the study period, of whom 57.1% were female and 42.9% male. Pain was mainly moderate (51.4%), provoked (80%) and pressure-type (45.7%).

Radiographic findings revealed 51.4% apical periodontitis, 45.7% periradicular periodontitis and 20% root cracks. These failures were mainly due to poor post insertion and inadequate root canal filling.

Corono-radicular reconstruction is the last resort for conserving decayed teeth, and preventing its failure is therefore of paramount importance.

Keywords: Coronal-radicular reconstruction; Endodontic treatment; Root canal filling; Post-operative pain; Root fracture

1. Introduction

Corono-radicular reconstruction (CRR) is a restoration that involves both the coronal and root portions of a decayed tooth [1]. This restoration uses intraradicular posts to preserve the definitive crown and minimize the stresses applied to the abutment teeth. It is indispensable in fixed prosthetics in clinical situations where coronal retention of the abutment of the future prosthesis is reduced [2]. The aim of coronal-radicular reconstruction is to restore the tooth to its original shape, while protecting it from reinfection [3].

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Pre-prosthetic endodontics is the first step in this type of prosthetic restoration, involving the preparation of a root-canal space to accommodate an anchor for the future prosthesis. As with any surgical procedure, it can be accompanied by a number of complications of varying nature, leading to short- or long-term failure. Root perforation of the middle or apical third and root fracture of the abutment tooth have been the most frequently reported in studies. They are caused by misjudgment of root direction during gutta removal or canal widening, iatrogenic injury [4], inadequate root canal preparation, overloading during lateral condensation of gutta-percha, inadequate sealing technique and selection of intraradicular posts [5], and inadequate root canal preparation and filling [6,7].

Under these conditions, an acute inflammatory reaction will be triggered by this aggression, leading to the release of chemical mediators resulting in local edema that increases periapical tissue pressure, causing postoperative pain in endodontics or fixed prosthetics. Its incidence varies from study to study. In 2008, Sathorn and *al* found that the incidence of postoperative pain in endodontics ranged from 3% to 58% [8]. In 2013, a prospective clinical study based on 374 root canal treatments found a high incidence of pain of 47.3%, including 69.5% during the first two postoperative days [9]. In France in 2012, pain accounted for 18.4% of reasons for crown tooth extraction [10]. In Morocco, pain was the most frequently encountered reason for consultation in the case of a conjoint prosthesis, with a percentage of 63% [11]. Thus, this study was carried out in order to :

- Determine the frequency of pain following prosthetic coronal-radicular reconstruction
- Describe the characteristics of the pain
- Identify the factors that cause this pain

2. Material and methods

This is a prospective, descriptive, cross-sectional study, carried out from March 2023 to November 2023 in a University Hospital (CHUPZAGA) Androva Mahajanga and a private dental practice located in Tanambao Ambalavato Mahajanga. The study population consisted of 35 patients undergoing coronal-radicular reconstruction who came for consultation at the health center. Exhaustive sampling was chosen to constitute the sample. Patients aged 18 and over, with prosthetic coronal-radicular reconstruction and post-prosthetic pain were included in the study, while uncooperative patients and those with mental disabilities were excluded.

The following elements and information were recorded:

- Social characteristics (gender, age),
- Tooth location,
- Type of prosthesis according to material used,
- Type of post,
- Clinical appearance of abutment teeth (presence of redness, swelling, mobility),
- Radiographic appearance of abutment teeth (axis of post insertion, presence of cracks, peri-radicular, radiolucent image, peri-apical radiolucent image),
- Pain characteristics (onset, intensity, period of onset, pain description).

2.1. Evaluation criteria

2.1.1. For pain: Visual Analogue Scale (VAS)

This is the scale used to define the intensity of the subject's pain.

A pre-established, tested and validated anonymous questionnaire was used to collect information.

Information was collected in the form of an individual interview. Free and informed consent was obtained from the patients interviewed, after the objectives of the study had been clearly explained to them. Confidentiality was respected.

Data were analyzed using Statistical Package for Social Sciences (SPSS) 20.0 software. Then the association between pain characteristics and clinical and radiographic aspects of the abutment teeth was performed using the chi-square test. Results were considered significant for a $p < 0.05$ value, provided the test conditions were met.

Conflict of interest: none

3. Results

Table 1 Sample distribution by social profile

Social profile	Effective	Proportion (%)
Gender		
Male	15	42.9
Feminine	20	57.1
Total	35	100
Age range		
18 to 24 years	13	37.1
25 to 34 years	12	34.3
35 to 44 years	9	25.7
45 and over	1	2.9
Total	35	100

Average age = 29

Table 2 Sample distribution according to prosthetic coronal-radicular reconstruction

Corono-root reconstruction	Effective	Proportion (%)
Tooth concerned		
Antero-mandibular	5	14.3
Posteromandibular	5	14.3
Antero-maxillary	18	51.4
Postero-maxillary	7	20
Total	35	100
Types of materials used		
Resin	21	60
Metal-ceramic	14	40
Metal-ceramic	00	00
Total	35	100
Types of post used		
Screw post	18	51.4
Fibrous post	11	31.4
Metal tenon	6	17.1
Total	35	100

Table 3 Sample distribution by radiography practice

Practical radiography	Effective	Proportion (%)
Preoperative		
Yes	6	17.1
No	29	82.9
Total	35	100
Intraoperative		
Yes	4	11.4
No	31	88.6
Total	35	100
Postoperative		
Yes	00	00
No	35	100
Total	35	100

Table 4 Sample distribution according to pain characteristics

Pain characteristics	Yes		No		Total	
pain onset	Effective	Proportion	Effective	Proportion (%)	Effective	Proportion (%)
Less than 3 months	15	42.9	20	57.1	35	100
3 to 6 months	07	20	28	80	35	100
Over 6 months	13	37.1	22	62.9	35	100
Intensity						
slight	08	22.9	27	77.1	35	100
moderate	18	51.4	17	48.6	35	100
Intense	09	25.7	26	74.3	35	100
Description of pain						
Spontaneous Pain	07	20	28	80	35	100
Induced pain	28	80	07	20	35	100
Swelling	15	42.9	20	57.1	35	100
Pressure pain	16	45.7	19	54.3	35	100
Dull pain	10	28.6	25	71.4	35	100
Stubborn pressure	10	28.6	25	71.4	35	100

Table 5 Sample distribution according to clinical and radiographic assessments

Balance sheet	Yes		No		Total	
	Effective	Proportion	Effective	Proportion	Effective	Proportion
Clinic						
Redness	8	22.9	27	77.1	35	100
Swelling	15	42.9	20	57.1	35	100
Mobility	12	34.3	23	65.7	35	100
Radiographic						
Inadequate root canal filling	14	40	21	60	35	100
Wrong axis of insertion without root intrusion	10	28.6	25	71.4	35	100
wrong axis of insertion with root effraction	16	45.7	19	54.3	35	100
Crack	07	20	28	80	35	100
Periradicular radiolucent image	16	45.7	19	54.3	35	100
Periapical radiolucent image	18	51.4	17	48.6	35	100

Table 6 Sample distribution according to radiographic findings and pain intensity

Radiographic workup	Pain intensity			p
	Light n(%)	Moderate n(%)	Intense n(%)	
Wrong axis of insertion without root effraction				
Yes	06(60)	3(30)	1(10)	0.004
No	02(8)	15(60)	8(32)	
Wrong axis of insertion with root effraction				
Yes	00 (00)	08(50)	08 (50)	0.001
No	08 (42.1)	10 (52.6)	1 (5.3)	
Crack				
Yes	04 (57.1)	02 (28.6)	01(14.3)	0.05
No	04 (14.3)	16 (57.1)	8 (28.6)	
Radiolucent periradicular image				
Yes	00(00)	08(50)	08(50)	0.001
No	08(42.1)	10(52.6)	1(5,3)	
Clear periapical X-ray image				
Yes	08(44.4)	09(50)	1(5,6)	0.001
No	00(00)	09(52.9)	08(47.1)	

n = effective

Table 7 Distribution of samples according to radiographic findings and pain characteristics

Radiological Check-up	Pain characteristics									
	Start (month)				Description of pain					
	≤ 3 n(%)	4 to 6 n(%)	More than 6 n(%)	p	Spontaneous n(%)	Provoked n(%)	Swelling n(%)	Pressure n(%)	Deaf n(%)	Stubborn pressure
Wrong insertion axis without break-in	00(00)	2(20)	8 (80)	0.002	5 (50) p=0.005	5(50) p=0.005	6(60) p=0.195	4(40) p=0.668	4(40) p=0.344	4(40) p=0.344
Root invasion by the post	15(93.8)	1(6,2)	00(00)	0.000	00(00) p=0.007	16(100) p=0.007	4(25) p=0.050	8(50) p=0.640	5 (31.2) p=0.748	3(18.8) p=0.238
Crack	00(00)	1(14.3)	6(85.7)	00.009	5(71.4) p=0.000	2(28.6) p=0.000	6(85.7) p=0.010	2(28.6) p=0.309	2(28.6) p=1.000	4(57.1) p=0.061
Periradicular radiolucent image	15(93.8)	1(6,2)	00(00)	0.000	00(00) p=0.007	16(100) p=0.007	4(25) p=0.050	8(50) p=0.640	5(31.2) p=0.748	3(18.8) p=0.238
Apical X-ray image	00(00)	5(27.8)	13(72.2)	0.000	7(38.9) p=0.004	11(61.1) p=0.004	10(55.8) p=0.118	7(38.9) p=0.404	5(27.8) p=0.915	6(33.3) p=521

4. Discussion

The present study is a prospective cross-sectional descriptive study conducted over a 9-month period. Thirty-five (35) patients with painful corono-radicular reconstruction were studied. This circumstance was found to be fairly frequent in this study, i.e. 4 patients per month, and Amrani AY and *al* confirmed in their study that 63% of patients with a conjoint prosthesis suffered from pain [11]. This pain is represented 18.4% of the reasons for crown tooth extraction according to Tanguy M and *al* in 2012[10].

4.1. Social characteristics

In this study, women predominated (57.1%), with a sex ratio of 0.7 (Table 1). This means that women are more motivated in the fixed prosthetic management of decayed teeth than men. In contrast, Thioune N and *al* found that more men than women had fixed dentures (51.55% vs. 48.45%), giving a sex ratio of 1.06 [12].

The overall mean age was 29 years, with the 18-24 age group accounting for 37.1% of the populations studied. Our population was younger than that of patients in the study by Thioune N and *al*, with an average age of 42.9 ± 13.14 years[12].

4.2. Pain characteristics and affected teeth

This study showed that maxillary anterior teeth were the teeth most affected by pain (51.4%) (Table 2). As these anterior teeth are single-rooted, practitioners may consider endodontic treatment and root post placement to be easy and straight forward, thus influencing their quality of work, the source of treatment failures. According to the study by Schmitter M and *al*, anterior teeth were at greater risk of failure than posterior teeth [13].

Most patients experienced pain at three months or less (42.9%) post-prosthetically. Pain was often provoked (80%) and moderate (51.4%), associated with swelling with or without fistula (42.9%). Some patients presented with pressure-type pain (45.7%), dull pain (28.6%) and stabbing pressure (28.6%) (Table 4). These pain characteristics are often encountered in a variety of cases of root fracture or apical periodontitis linked to faulty endodontic treatment and root canal preparation.

4.3. Factors for the occurrence of pain on a coronaradicular reconstructed abutment tooth

4.3.1. Apical periodontitis

Fifty-one point four percent (51.4%) of patients had apical periodontitis on the abutment tooth (Table 5). Apical periodontitis is a pathology often encountered on endodontically treated teeth and its frequency in this study is high compared with the study by Gheorghe AG and *al* (2019), Conert T and *al* (2018) and Koutsouri MH (2022), who found 49.80%, 34% and 7.7% respectively [14, 15,16]. This pathology accounted for almost 30% of reasons for crown tooth extraction [10].

In general, the pain of apical periodontitis was essentially moderate, and provoked by the presence of swelling at the back of the vestibule. A highly significant correlation was found between this pathology and the intensity and factors triggering pain ($p = 0.001$ and 0.004) (Table 6 and 7). The clinical characteristics of postoperative pain in endodontics are common to the descriptions of acute apical periodontitis. The pain is continuous, with localized throbbing, aggravated by occlusal pressure or periradicular palpation. In the case of an asymptomatic necrotic tooth, pain sets in hours or days after treatment, whereas in the case of a tooth with preoperative periodontal symptoms, it is persistent, with aggravation or improvement of the pre-existing pain quality [17]. Hence the importance of radiography, which was found to be less important in this study (17.1% preoperative, 11.4% intraoperative and none postoperative) (Table 3). The fact that the majority of practitioners do not have an X-ray machine in their practice could lead them to carry out coronal-radicular reconstruction without radiography, especially if the teeth are asymptomatic.

4.3.2. Peri-radicular periodontitis associated with root perforation

Among the samples, 45.7% had periradicular periodontitis (radiolucent image at the lateral or furcation level of the root) following root perforation by posts (Table 6). Iatrogenic perforation is a major complication of endodontic and restorative treatment in the furcation zone and lateral axial canal walls, and occurs even in the most experienced patients [18]. When perforation occurs, inflammatory and infectious periodontal consequences develop rapidly, due to the lower resistance of this area [19]. According to some studies, 2-12% of endodontically-treated teeth suffer from root perforation [18]. Peri-radicular periodontitis frequently manifested itself as pain 3 months or less after coronal-radicular reconstruction (93.8%). Pain was provoked (100%), pressure (50%) and dull (31.2%) (Table 7). There was a significant association between pain triggers, $p = 0.007$.

4.3.3. Crack

Radiological examination has shown that 20% of patients have a root crack on the abutment tooth. With the stresses of masticatory forces, this crack can develop into a root fracture, leading to treatment failure. The study by Schmitter M and *al* reported that 17 teeth with coronal-radicular reconstruction had to be extracted due to fractures [13].

Regarding signs of cracking, the majority of these patients (85.7%) experienced pain beyond 6 months post-prosthetic treatment. Mostly mild and moderate pressure-type pain was observed (Table 7). Mild mobility, redness and a small fistula were observed clinically on the vestibular mucosa of the abutment teeth. Mild pain on mastication (60-100%), sensitivity to percussion (6.66%) and palpation of the bone tables (6.66%) were also reported as clinical symptoms in numerous studies. Clinical signs were fistula (31 to 46.6%), isolated periodontal pocket (>6 mm) (40%), localized swelling (23 to 77%), purulent discharge from fistula (6.66%), purulent discharge from sulcus (3.33%) and tooth or fragment mobility (3 to 45%) [20,21].

In this study, several reasons were identified for the occurrence of this crack:

- Deviation of the drilling axis of the root canal post housing without root effraction with thinning of the root walls (28.6% of cases). According to Farina *ap et al*, root canal drilling is responsible for the weakening of the root creating the formation of brittle points even before post insertion [22]. Hin ES and *al* in 2013 and Capar ID and *al* in 2014 added that post-space preparation with forests had a significant effect on apical crack propagation. This may be due to reduced residual dentin thickness and excessive forces caused by rigid forests [23,24]. In addition, the post will exert a wedge effect on the weakened area, leading to tooth fracture in the short to medium term.
- Some teeth have shown apical cracks but without post deviation, and patients have never suffered trauma. The reason for this could be that the use of rotary instruments can make root tooth tissue more susceptible to cracking, as several recent studies have shown. Indeed, the Protaper Universal NiTi rotary system (in particular the F2 file) had a significant effect on crack initiation specifically at the apical level [25]. Crack initiation was greater with the Protaper Universal instrument than with other brands of rotary instruments. This could be

tributed to the rigidity of the larger instruments [23,24]. Other studies have speculated that over loading during lateral condensation of gutta-percha, sealing technique and root canal filling are involved in this problem [26,27].

- To the subject of post type, the greatest number were screw posts (51.4%) and fibrous posts (31.4) and the least used were metal posts (17.1%) (Table 2). Screw post retention is ensured by the thread on their surface, and they are screwed into the root dentin. This type of active post creates more stress during insertion and function than any other type of root post, known as a passive post [28]. These cracks are probably caused by inadequate selection of intra-root posts [26]. Some studies have argued that metal posts generate higher stresses that can lead to catastrophic fractures than fibrous posts. The latter have a better stress distribution, favoring long-term fracture-free survival [29, 30]. However, Marchionattema and *al* have demonstrated that both types of post offer similar clinical performance and are good alternatives for restoring endodontically treated teeth [31].

5. Conclusion

Corono-radicular reconstruction is a prosthetic treatment whose success depends on both endodontic treatment and crown veneering. The circumstances in which pain may occur in a tooth restored by this type of treatment are numerous, and this study aims to identify them.

The study highlighted that pain was a sign evoked by infection of the surrounding periodontal tissues (peri-radicular and apical) and fissures essentially of iatrogenic causes.

Overall, pain was moderate, provoked and occurs a few months post-prosthetic. It is accompanied by fistula and/or edema on the vestibular mucosa of fissure-abutting teeth, swelling at the back of the vestibule for apical periodontitis, and periodontal pockets for periradicular periodontitis. These post-prosthetic complications can lead to extraction of the teeth concerned, which means failure of the coronal-radicular reconstruction.

As a result, some patients may be discouraged from investing in the management of teeth damaged by this type of treatment. To prevent and minimize these problems, practitioners must take into account the various risk factors for failure of a coronal-radicular reconstruction, and give particular importance and rigor to the great endodontic and prosthetic principle.

Compliance with ethical standards

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Disclosure of conflict of interest

The authors declare no conflicts of interest.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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