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Periodontal Bone Regeneration of CSC Telescopic Abutments for The Treatment of Cases Affected Severe Advanced Periodontitis with Secondary Occlusal Traumatism - A Retrospective Long-Term Study

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Abstract

The purpose was to investigate evidenced-based clinical trials of abutments with severely advanced periodontitis (SAP) as the effect for the long-term options.

Materials and Methods: The present study was based on a retrospective analysis from 26 patients affected severe advanced periodontitis and secondary occlusal traumatism (SOT). Proper informed consent was obtained from the patients and control individuals. All patients were in good health with no contraindications to dental treatment. The study was to focus on the abutments of results of via periodontal therapy procedures including therapeutic provisional prosthesis (TPP), non-surgical periodontal therapy (NSPT), and crown and sleeve-coping telescopic denture (CSCTD). Records confirmed that the samples received TPP, NSPT, and CSCTD from 5.1years to 39 years in maxillary and mandibular abutments.

Results: Results showed that of the 139 abutments examined, 5 non-molar and 6 molar abutments were lost, giving a success rate of 92.1% in maxillary abutments. A total of 131 teeth were evaluated on both 3 non-molar and 5 molar abutments were lost giving successful rates of 93.2 % in mandibular abutments.

Conclusions: The conclusions showed that cases affected SAP with SOT got the success rates of both maxillary and mandibular teeth abutments were 92.1% and 93.2%, respectively, using combined techniques of TPP, NSPT and CSCTD.

Keywords: SAP, SOT, TPP, NSPT, CSCTD

Abbreviations: SAP: Severely advanced periodontitis; SOT: Secondary occlusal traumatism; TPP: Therapeutic provisional prosthesis; NSPT: Non-surgical periodontal therapy; CSCTD: Crown and sleeve-coping telescopic denture; CAL: Clinical attachment levels; RABL: Radiographic alveolar bone loss; FI: Furcation involvement; SPT: Surgical periodontal therapy; GTR: Guided tissue regeneration; RSR: Root separation and /or resection; DSRIA: Digital scanning radiographic image analysis

Introduction

The published reports addressed that non-surgical periodontal therapy (NSPT) may not only dramatically improve clinical and microbiological parameters, but also resolve inflammation and arrests adult periodontitis [1-4]. There still exist some problematic areas, such as, FED, furcal concavity, osseous defects, usually correlated with deep pockets that may adversely respond to NSP because of these sites limited access to debride bacterial deposits. In addition, clinical studies indicated that deep pockets in the molar furcation involvements have prone to more attachment loss and higher mortality rate when observed over many years [5-8]. The finding of minimal bone fills after scaling and root planning contrasted with the findings of bone fills, which were reported by Rosling et al. [9] and Polson & Heijl [10] that abundant bone repair, post-surgically. There exists conflicting data regarding the bone fills of angular bony defects following surgical and non-surgical periodontal therapy. Renvert et al. [11] indicated that limited repair in treating intra-osseous defects using flap operation and

there was virtually no bone fill after root planning. It can be argued that the lose rate of periodontal attachment levels is influenced by some deteriorative factors such as type of plaque infection, host susceptibility, and the local environment of chronically inflamed tissue, pathologically deepened pockets resulted from foods impaction, ill-fitting restorations, crowding of teeth, morphology of alveolar bone, trauma from occlusion etc. In cases of individuals with SAP were most affected by SOT. Once not only characterized by severe periodontal attachment loss and reduced height of the alveolar bone but frequently also reveal a remarkably increased mobility of teeth.

SOT of the jigging type with concomitant increased hypermobility of teeth induced a series of periodontal tissue alterations associated with clinical and radiographic symptoms such as teeth hypermobility, pathological migration, angular bone defects, disappearance of lamina dura, widening of periodontal ligament. To present a gradual mechanical extraction of teeth with SAP, splinting using the periodontal prosthetic therapy for full mouth oral rehabilitation should be carried out as a prevention of treatment purposes of masticatory function, the patient's comfort, elimination of SOT, and esthetic dentistry. The purpose of this report was, retrospectively and longitudinally, to investigate survival rates of abutments with severely advanced periodontitis [SAP, alveolar bone loss > 60 %] with SOT using NSPT, temporary provisional prosthesis (TPP) and CSCTD (Figure 1) as the effect for the evidenced-based clinical trials options.

Figures 1: Clinical pictures of maxillary CSCTD design of inner crown abutments (1a: occlusal view) at #14, #13, #24, #25, and telescopic denture (1b: facial view).

Materials and Methods

The present article is one of extension of our serial study on the field of periodontal prosthetic therapy for the treatment of individuals with severely advanced periodontitis (SAP, alveolar bone loss > 60 %). The present study was based on a retrospective analysis from 26 patients affected SAP and SOT. Proper informed consent was obtained from the patients and control individuals. The total abutments of 270 teeth were selected from graduate institute of dental sciences of medical university. Teeth consisted of both maxillary group [139 abutments] and mandibular group [131 abutments]. All patients were in good health with no contraindications to dental treatment. The individuals affected SAP and SOT treated using TPP, NSPT, and CSCTD (Figure 1) were signed as the treatment group. The present study was to focus on the survival rates of CSC telescopic abutments via routine periodontal therapy procedures including combination of TPP, NSPT, and CSCTD periodontal prosthetic procedures. The mean age of the samples was 54.4 ± 9.1. Record reviews confirmed that the total samples received TPP, NSPT, and CSCTD presented from 5.1years to 39 years with a mean 11.0±6.0 years [median 10.3 years] and 10.1±7.3 years [median 7.5 years] in maxillary and mandibular teeth, respectively (Tables 1 & 2).

Clinical examination

The clinical examination of periodontal parameters conducted on the molars included gingival index, [12] plaque index, [13] periodontal probing depth, horizontal and vertical clinical attachment levels (CAL: the distance in mm between the CEJ and apical end of the probing depth) and root mobility recorded for six sites on each tooth surface, at the baseline, 6 months, 1 year, and follow-up throughout the end of study. The percentages of RABL at the alveolar bone crest for each abutment was determined by measuring the medial and distal alveolar crest with most apical defect to the root apex from standardized parallel periapical and /or vertical bite-wing radiographs at baseline, margin of TPP, and inner crown margin [14]. The superimposed and unclear radiographs could not be used to determine the levels of radiographic alveolar bone loss [RABL] in the mesial and distal osseous defects. The removable TPP was fabricated not only for splinting the mobile teeth, but also for stabilizing the teeth with SOT. This removable TPP design is prepared as the precursor of permanent periodontal prosthesis of CSC retainer and CSCTD [15,16]. All treatment was performed by the same clinician. Supportive periodontal treatment recalled for reinforced oral hygiene instruction at two to three month's appointments for

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personal plaque control by patient, as well as professional plaque control by clinician.

Results

Results showed the list of CSCTD abutments location, ranges of RABLs, abutment loss, treatment procedures and successful rates, follow-up periods from 5.1 to 39 years in a both maxillary and mandibular teeth in a total of 28 cases. The means (SD) and ranges of initial radiographic alveolar bone loss (RABL) from 36.2±12.5 % to 66.0±15.5 % (ranged from 18.0% to 100 %) versus from 34.4±6.4 % to 64.3±3.8 % (from 18.0 % to 72.9 %) for maxilla and mandible, respectively. (Tables 1 & 2). Table 3 demonstrated the failure rates of teeth as the CSC telescopic abutments in both maxilla and mandibular arches using the combination of TPP, NSPT, and CSCTD techniques. Among 139 maxillary abutments, treated by the combined procedures of TPP, NPT, and CSCTD examined, 11 abutments were lost, giving a loss rate of 7.9 % and survival rate of 92.1% and after the end of study with a means elapsed time of 11.0±6.0 years. Of the 139 abutments examined, 5 non-molar abutments were lost, giving a loss rate of 3.6% in maxillary non-molar abutments, while 6 molar abutments were lost, giving a loss rate of 4.3%.

Table 1: Loss rates of maxillary abutments of CSCTD treatment procedures at baseline data and follow-up periods. (Red color no.: abutment loss) Non-molar(N-m): N-m=5/139(LR=3.6%); Molar(M), M=6/139(LR=4.3%); N-m+M=11/139 (LR=7.9%); LR: total loss rate (n): 92.1% (128/139); Follow-up periods (5.1-39 years); Periods: Mean(SD) = 11.0(6.0) years; x: teeth missing; Abut.: abutment; RABL(%): radiographic alveolar bone loss.

Case no	CSCTD Abutments	RABL (%) Ranges	Abutment lost	Treatment Procedures	Periods years
1	17,15,14,13,22,23,24,27	33.3-100	2	PP/NSPT/CSCTD	39
2	18,17,15,14,22,25,26,27	38.3-90.2	2	PP/NSPT/CSCTD	21
3	x	x	x	x	x
4	17,16,15,13,12,22,23,24,27,28	18.0-42.2	3	PP/NSPT/CSCTD	12
5	16,14,23,24,25	40.1-52.4	0	PP/NSPT/CSCTD	8.6
6	18,15,14,24,25,28	28.4-56.8	0	PP/NSPT/CSCTD	7.2
7	x	x	x	x	X
8	16,15, 24,26,27,28	35.6-64.1	0	PP/NSPT/CSCTD	6.4
9	17,15,14,23,24,27	30.2-61.8	0	PP/NSPT/CSCTD	7.1
10	16,14,12,21,25,27	30.3-73.4	1	PP/NSPT/CSCTD	7
11	17,15,14,12,11,24,25,27	46.4-73.6	1	PP/NSPT/CSCTD	5.8
12	13,12,11,21,23,24,26,27	26.3-50.9	0	PP/NSPT/CSCTD	5.2
13	13,12,22,23,24,25	21.9-66.3	0	PP/NSPT/CSCTD	7.5
14	17,15,13,26	43.8-76.2	0	PP/NSPT/CSCTD	9.3
15	13,12,11,23,26	38.0-54.9	0	PP/NSPT/CSCTD	18.3
16	15,14,21, 22,25,24,26	22.4-45.5	0	PP/NSPT/CSCTD	10.4
17	16,13,12,11, 22,24	41.7-76.7	0	PP/NSPT/CSCTD	13.5
18	13,12, 23,25	34.5-76.2	2	PP/NSPT/CSCTD	10.8
19	x	x	x	x	x
20	x	x	x	x	x
21	17,15,14,12,11,21,22,27	32.1-79.6	0	PP/NSPT/CSCTD	12.6
22	16,14, 24	61.6-79.2	0	PP/NSPT/CSCTD	11.9
23	x	x	x	x	x
24	17,16, 26, 27	70.5-90.4	0	PP/NSPT/CSCTD	12
25	17,15,21,25,27	28.1-54.6	0	PP/NSPT/CSCTD	10.2
26	17,24,26,28	49.7-78.6	0	PP/NSPT/CSCTD	5.1
27	18,17,15,22,25,27,28	30.8-50.5	0	PP/NSPT/CSCTD	13
28	13,11,21,23,25	32.9-46.9	0	PP/NSPT/CSCTD	17.1
Total	LR: 7.9% (11/139)	18.0-100	11	PP/NSPT/CSCTD	5.1- 39
no.	Mean (SD)	34.4(6.4)-64.3(3.8)	Molar: 6		11.0(6.0)
	median	33.1-65.2	Non-molar: 5		10.3

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Table 2: Loss rates of mandibular abutments of CSCTD treatment procedures at baseline data and follow-up periods (5.2-39 years; median = 7.5 years).

Cases Case no	CSCTD Abutments	RABL (%) Ranges	Abuts. Lost	Treatment Procedures	Periods years
1	47,45,33,35,37	34.6-63.2	1	TPP/NSPT/CSCTD	39
2	x	x	x	x	X
3	47,43, 34,35	37.2-72.8	1	TPP/NSPT/CSCTD	6.5
4	47,45,44,43,42,33,35,36,38	29.5-59.5	1	TPP/NSPT/CSCTD	12.6
5	44,43,42,41, 31,32,33,37	31.7-62.5	0	TPP/NSPT/CSCTD	8.6
6	45,44,43,33,34,38	35.4-62.4	0	TPP/NSPT/CSCTD	7.2
7	44,43, 35,36	42.8-61.7	1	TPP/NSPT/CSCTD	10
8	48,47,45, 33,34	38.9-63.4	0	TPP/NSPT/CSCTD	6.4
9	47,45, 33,35,37	33.1-66.3	0	TPP/NSPT/CSCTD	7.1
10	48,45,44,34,38	39.4-65.3	0	TPP/NSPT/CSCTD	7
11	x	x	x	x	x
12	43,42,41,31,32,33,36	31.6-60.4	0	TPP/NSPT/CSCTD	5.2
13	43,42,33,36	39.1-63.7	0	TPP/NSPT/CSCTD	7.5
14	x	x	x	x	x
15	46,43,42, 31,32,33,34,37	18.6-69.2	0	TPP/NSPT/CSCTD	18.3
16	47,43, 34,36	37.2-72.9	1	TPP/NSPT/CSCTD	6.7
17	47,45,44,43,42, 33,35,36	29.5-59.6	1	TPP/NSPT/CSCTD	6.4
18	44,43,42,41, 31,32,33,38	31.7-62.6	0	TPP/NSPT/CSCTD	6
19	45,44,43, 33,34	35.3-62.5	0	TPP/NSPT/CSCTD	5.7
20	44,43, 35,37	42.8-61.8	1	TPP/NSPT/CSCTD	5.4
21	48,47,45, 33,35	38.9-63.5	0	TPP/NSPT/CSCTD	12.6
22	47,45, 33,35,38	33.1-66.4	0	TPP/NSPT/CSCTD	6.7
23	48,45,44,34	39.4-65.4	0	TPP/NSPT/CSCTD	6.4
24	x	x	x	x	x
25	43,42,41,31,32,33,37	31.6-60.5	0	TPP/NSPT/CSCTD	9.8
26	43,42,33,37	39.1-63.8	0	TPP/NSPT/CSCTD	12.1
27	x	x	x	x	x
28	46,43,42,31,32,33,34,38	18.0-69.3	1	TPP/NSPT/CSCTD	19.3
Total	LR:6.1 % (8/131)	18.0-72.9	8 (6.1%)	TPP/NSPT/CSCTD	5.2-39
cases	Mean (SD)	34.4(6.4)-64.3(3.8)	Molar: 5		10.1(7.3)
	Median	35.0-63.4	Non-molar: 3		7.5

Non-molar(N-m): N-m=5/139(LR=3.6%); Molar(M), M=6/139(LR=4.3%); N-m+M=11/139 (LR=7.9%); LR: total loss rate (n): 92.1% (128/139); Follow-up periods (5.1-39 years); Periods: Mean(SD) = 11.0(6.0) years; x: teeth missing; Abut.: abutment; RABL(%): radiographic alveolar bone loss.

Table 3: Success rates of teeth as the CSC telescopic abutments in both maxilla and mandible using the combined procedures of TPP, NSPT and CSCTD after the end of study from 5.1 to 39 years.

CSC Telescopic abutments (n) (%)	Maxilla abutments (n) (%)	Mandible abutments (n) (%)	Total abutments (n) (%)
Molar loss (n) (%)	133/139 (95.7%)	126/131 (96.2%)	259/270 (95.9%)
Non-molar loss (n) %	134/139 (96.4%)	128/131 (97.7%)	262/270 (97.0%)
Total abutments loss (%)	128/139 (92.1%)	123/131 (93.9%)	251/270(93.0%)

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(Table 3) Out of 131 mandibular abutments, treated by the combined procedures of TPP, NSPT, and CSCTD evaluated, 8 abutments [3 non-molar and 5 molars] were lost, giving a 6.1% loss rates and survival rates of 93.9% after the end of study with a mean elapsed time of 10.1±7.3 [median=7.5] years. Both the 97 non-molar and 34 molar abutments a [total of 131 abutments] were evaluated, both molar (3/131) and non-molar (5/131) abutments were lost, giving a loss rate of 2.3 % and 3.8 % only, respectively (Table 3). (Table 4) indicated that the total RABL (%) mean (SD) ranges of RABL (%) and median on the CSC telescopic abutments in both maxillary and mandibular arches. The loss of RABL (%) in maxillary abutments was 18.0 % to 100%, where there in mandibular abutments was 18.0% to 72.9%, respectively. The total RABL (%) loss of both maxillary and mandibulr abutments was 18.0% to 100%. The means (SD) of RABL in maxillary and mandibular abutments were from 36.2±12.5% to 66.0±15.5% with a median 33.1% to 65.2%, and 34.4±6.4 to 64.3±3.8 with a median 35.0% to 63.4%, respectively. (Table 5) illustrated the treatment on the CSC telescopic abutments in both maxillary and mandibular arches using combined procedures of TPP, NSPT, and CSCTD in longitudinal clinical trials during 5.1 to 39 years. The treatment periods of maxillary and mandibular abutments were 5.1 to 39 years and 5.2 to 39 years. Result also showed that the means (SD) years of maxillary and mandibular abutments were 11.0±6.0 years with a median 10.3 years and 10.1±7.3 years with a median 7.5 years, respectively.

Table 4: The means (SD) of radiographic alveolar bone loss (RABL%) of CSC telescopic abutments in both maxillary and mandibular teeth.

CSC Telescopic abutments	Maxilla (%)	Mandible (%)	Total RABL (%)
Total RABL (%)	18.0 - 100	18.0 - 72.9	18.0 - 100
Mean (SD) (%)	36.2(12.5)- 66.0(15.5)	34.4(6.4) - 64.3(3.8)	34.4(6.4)- 66.0(15.2)
Median	33.1- 65.2	35.0 - 63.4	33.1 - 65.2

Table 5: The treatment periods on the abutments for the combined procedures of TPP, NSPT and CSCTD from 5.1 to 39 years.

CSC telescopic abutments	Maxilla	Mandible	Total follow-up (years)
Treatment	5.1- 39	5.2 - 39	5.1 - 39
periods (years)			
Mean (SD)(years)	11.0(6.0)	10.1(7.3)	10.1(7.3)- 11.0(6.0)
Median (years)	10.3	7.5	

Figure 2: Periapical radiographs showed cases of affected moderate to severe alveolar bone loss and SOT around both maxillary and mandibular teeth at the baseline data February 20, 2013.

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Representative Case

A 51-year-old female Taiwanese was referred from a local dental clinic for seeking the management of her severe advanced periodontitis in 2013. According to the chief complaints of patient included gingival bleeding, gingival recession, recurrent swelling with purulent exudation and generalized hypermobile teeth of full mouth. Severe advanced alveolar bone destruction, pathological teeth migration over bilateral maxillary premolars and molars and all around the anterior and posterior mandibular teeth, respectively. [Figure 2] Deep caries were noted at molar #47. Periodontal parameters of gingival index, (12) plaque index (13) revealed 2 to 3 scores. Grade III tooth mobility were noted at maxillary teeth #14, #13, # 23, #24, # 25, and mandibular teeth from #34 to #37, #33, #32 to #41 and #43, #45, #47, respectively. Initial probing pocket depths of maxillary and mandibular teeth were 7 mm or more, even reach to 10 mm, irrespective of both arches except maxillary teeth # 14, #12, # 11, #21, #22 and mandibular teeth #34, #43, and # 48. Molar furcation involvements were found at the teeth of #37, #36, #46, and #47. Periapical radiographs showed from moderate to severe alveolar bone loss around both maxillary and mandibular teeth. According to the related data associated with symptoms and signs of intraoral soft tissue and clinical evaluation of periodontal supporting hard tissues, a diagnosis of generalized aggressive periodontitis affected molar FI II to III with secondary occlusal traumatism (SOT) was established.

Treatment (Figure 2).

The treatment plan of periodontal and prosthetic procedures was consisted of oral hygiene instruction, TPP, NSPT. The patient was instructed in oral hygiene of personal and professional plaque control, routine meticulous scaling, root planning and subgingival curettage under the periodontist. Chlorhexidine gluconate solution (0.12%) was used for routine pocket irrigation following professional subgingival scaling and curettage. Removed hopeless teeth of maxillary tooth #23 and mandibular #35, #36, #37, #45, and #47. To reduce torque force and fulcrum line and stabilize periodontal support due to massive loss of periodontal bone. In addition, to decrease the crown root ratio on the CSC telescopic abutments, endodontic treatment of root canal therapy included both maxillary teeth at the #15, #14, #21, #22, #24, #25 and mandibular teeth at #34, #31, #41, #42, #43, #44 and #46 was necessary. Periodic recall visits for monitoring and reinforcement of professional plaque control were established during the first year. The provisional oral rehabilitation using TPP was constructed, then, NSPT follow-up with 2 to 4 weeks periods for 12 months. One year later, the results of clinical evaluation for the periodontal soft and hard tissues following TPP, NSPT, and periodontal prosthetic designs applications. To increase proprioception, improve retention, increase rigid vertical support and stability of the periodontal prosthesis, CSC telescopic denture was used as the more reliable and effective design. [17-19]. Regarding the periodontal bone healing on the CSC telescopic denture design at the baseline as compared to the treatment after 9 years and 3 months. Results showed the combined use of TPP, NSPT, and CSCTD effective not only provided periodontal soft tissue healing, but also promote peridontal bone gains. Periapical radiographs revealed that the remarkable alveolar bone fills with lamina dura in both maxillary and mandibular abutments teeth using CSCTD perioprosthetic design after 9 years 3 months (Figure 2 & 3).

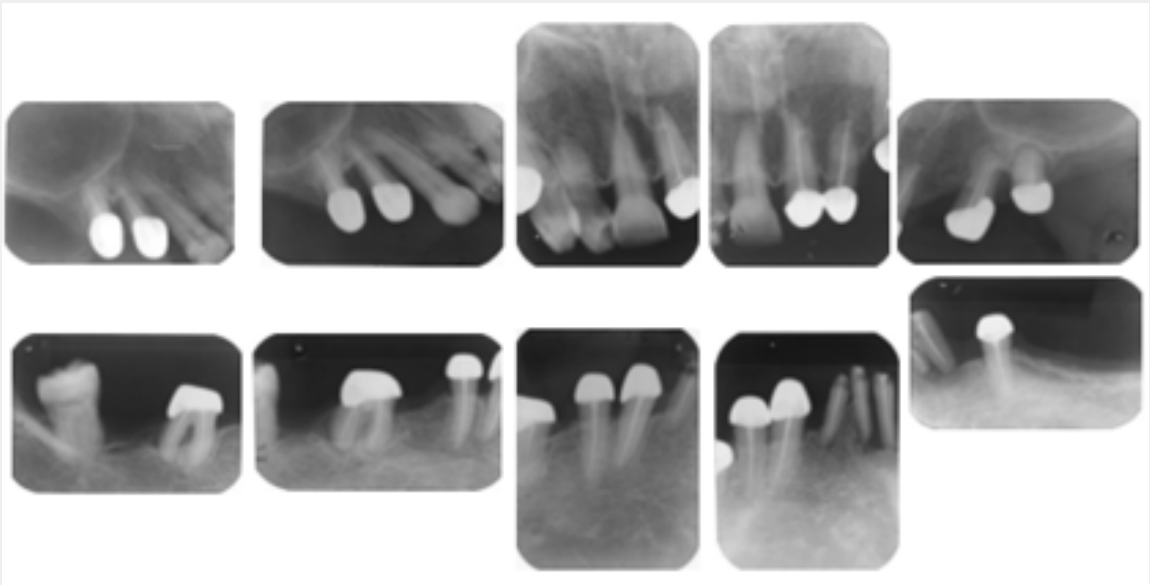

Figure 3: Periapical radiographs revealed that the remarkable alveolar bone fills with lamina dura in both maxillary and mandibular abutments teeth using the combined treatment of TPP, NSPT and CSCTD perioprosthetic design after 9 years 3 months on May 5, 2022.

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Discussion

Provisional crown has been recommended as a final approach of a therapeutic periodontal prosthesis (TPP) in the treatment of severely advanced periodontitis (SAP) with guarded prognosis. [15,20-22] The prosthetic design above techniques provided some advantages, including stabilizing hypermobile abutments, easy plaque control, decrease torque force, and reduce leveling force on the weak abutments affected SAP with SOT. The present study showed that clinical assessments of periodontal parameters using TPP, NSPT, and CSCTD (Figure 1a, 1b) restoration design revealed a remarkable soft and hard periodontal healing in both anterior and posterior abutments. Additionally, periapical radiographs revealed severe bone lose at the baseline; after follow-up periods over 9 years 3 months, results showed that complete repair of bony defects by bone fills, and reappearance of the lamina dura surrounding periodontal areas (Figure 2 & 3).

The majority of the discrepancy focused on the high prevalence of complications, such as root morphology, root fracture, recurrent invasion of furcation involvement (FI), incomplete plaque control over the residual root concavity, and treatment modalities. In addition, some studies. [4, 21-23] reported that factors such as anatomy and bony defects size between the bone and tooth, and amount and dimension of remaining periodontal tissues close to the defect are also important. However, these have more literature related to the treatment of the abutments affected SAP with SOT using surgical periodontal therapy (SPT) and combined SPT with guided tissue regeneration (GTR). Although, there still have many literatures associated with treatment of less periodontal bony support using the CSC retainers, but most of the public- shed data related to the successful treatment are limited on the case reports. [15,17] Recently, there are numerous reports associated with case series of SAP affected severe bony defects, SOT, molar FI using the combined periodontal and prosthetic treatments of TPP, NSPT and CSCTD (Figure 3) were presented. [18,19,24-26]. More recent literatures indicated a remarkable improvement in the periodontal parameters in advanced Class II and Class III molar FIs with root separation and /or resection (RSR) as compared to those without RSR [27]. Little or limited report associated with the longitudinal study on the survival rate of teeth as the abutments of CSCTD restoration in patient affected SAP with SOT. The former study seems also to be the first report using the digital scanning radiographic image analysis (DSRIA) to explore and, retrospective to evaluate the periodontal bone levels of a treatment option using a conservative periodontal therapy of TPP, NSPT combined with the CSCTD restoration [28]. Therefore, the long-term evaluation of perioprosthetic design of TPP, NSPT, and CSCTD may be provided an effective treatment philosophy for cases affected SAP with SOT.

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