

Clinical decision-making and management of stage IV periodontitis: A survey

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Abstract

Objective: To investigate the clinical management of stage IV periodontitis patients among clinicians within the Italian Society of Periodontology and Implantology.

Methods: A cross-sectional study was designed on a web-based anonymous survey. Comparison between ordinary members (OMs) versus active and certified members (ACMs) and comparison between members with at least 10 years of experience in periodontology (Ov10) and members with less than 10 years of experience in periodontology (Un10) were performed.

Results: A total of 324 out of 1362 members (response rate of 24%) responded to the questionnaire. ACMs and Ov10 more often reported their teams hold adequate skills to manage cases. Step I and II periodontal therapy took more time in the ACMs and Ov10 groups. ACMs used different strategies to perform step I-II therapy, and antibiotics were used less frequently than OMs. Unresponsive sites were treated more often with surgery by ACMs compared to OMs. ACMs adopted different treatment sequences compared to OMs. Ov10 group used more often CBCT, lateral cephalogram, and wax-up while Un10 group tend to avoid orthodontic therapy.

Conclusions: More experienced members spent more time in step I and II of periodontal therapy, used more diagnostic tools, and performed more often surgery and orthodontics in the treatment of stage IV periodontitis patients.

KEYWORDS

decision-making, dental implants, dental prosthesis, stage IV periodontitis, survey, tooth loss

1 | INTRODUCTION

Periodontitis is a chronic, multifactorial inflammatory disease associated with plaque biofilms characterized by specific anaerobic pathogens, that results in the progressive destruction of the tooth-supporting apparatus (Papapanou et al., 2018). It is the sixth most common condition in the world, with severe forms of the disease affecting 7%–11% of the adult population (Kassebaum et al., 2014).

The most severe form of periodontitis is represented by stage IV which is characterized by the presence of severe periodontal lesions that may extend beyond the apical third of the roots and history of

multiple tooth loss (Tonetti et al., 2018). It is frequently complicated by tooth hypermobility due to secondary occlusal trauma, posterior bite collapse and drifting of the anterior teeth due to the loss of the posterior ones. In these cases, the dentition is jeopardized and at great risk of being lost if the pathology is not adequately treated (Tonetti et al., 2018). Therefore, management of stage IV periodontitis requires complex rehabilitation due to the presence of chewing dysfunction (Tonetti & Sanz, 2019).

These cases must be recognized at the time of initial diagnosis to ensure adequate management. In fact, individuals with stage IV periodontitis have greater impairment of quality of life, self-reported

changes in food intake, and subjective and objective measures of chewing impairment compared to those affected by earlier stages of the disease (Uy et al., 2022).

An interdisciplinary approach is necessary to control periodontal infection, correct periodontal defects, eliminate residual pockets, realign migrated teeth, and re-establish adequate intermaxillary relationships (Jepsen et al., 2021; Montero et al., 2021; Ramanauskaite et al., 2021; Tomasi et al., 2021). The collaboration between different specialists and the adequate timing of rehabilitation are fundamental in the flow of therapy. Moreover, in patients with stage IV periodontitis retaining or extracting teeth, choosing any provisionals and establishing timing for orthodontic and surgical therapy may be a rather complex task to do.

Any clinical success depends on many variables such as the characteristics of the patient and his requests, cost analysis, and technical factors related to the operator (Lundgren et al., 2008). Decision-making is, therefore, a key aspect of daily clinical practice.

Many studies and surveys are present in the literature regarding the possible therapeutic options available in endodontic, periodontal, prosthetics, and implant therapy (Cosyn & DeBruyn, 2007; Junges et al., 2014; Bishti et al., 2018; Lee et al., 2020). The prognostic evaluation of compromised teeth among different operators with different experience and background also has been investigated extensively (Lang-Hua et al., 2014; Zitzmann et al., 2011). However, these studies are related to choices and management at tooth level without taking into consideration a multidisciplinary approach.

To our knowledge, decision-making process in complex clinical situations such as stage IV periodontitis has not been analyzed so far. The objective of the present study was to investigate the differences in the decision-making and management of stage IV periodontitis patients among trained clinicians from various backgrounds within the Italian Society of Periodontology and Implantology (SIdP). In particular, comparison between ordinary members (OMs) versus active and certified members (ACMs) and comparison between members with at least 10 years of experience in periodontology (Ov10) and members with less than 10 years of experience in periodontology (Un10) were investigated. This article follows the Consensus-Based Checklist for Reporting of Survey Studies (CROSS) (Sharma et al., 2021).

2 | MATERIALS AND METHODS

2.1 | Study design and data collection method

This was a cross-sectional study designed on web-based anonymous survey developed for periodontists in order to investigate on the decision-making and management of patients with Stage IV periodontitis. The questionnaire was administered in Italian. Appendix 1 shows the English translation of the questionnaire. The questionnaire was divided into two sections. The first section gathered general information of the respondents such as gender and educational qualification (6 questions), while the second section dealt

with the clinical approach in case of stage IV periodontitis cases (18 questions).

2.2 | Sample characteristics

The study population included 1362 dentists who were members of the Italian Society of Periodontology and Implantology (SIdP) in 2020 and/or 2021. Dental hygienists and student members were not included in the study population. SIdP includes several categories of members such as active, certified, ordinary, and junior members. Active members are those who are certified by the SIdP Board committee after passing an examination. They were 124. Certified members are those who earned a certificate in Periodontology issued either by the European Federation of Periodontology (EFP) or by an American Dental Association (ADA) accredited post-graduate program. Active members, holding the necessary requisites, may also belong to this category. They were 36. Ordinary and junior members are dentists licensed to practice in Italy who renew annually their membership. In particular, Junior members are those who have been previously registered as student members and who can hold this status for up to 2 years after graduation. Ordinary and junior members were collectively 1202.

2.3 | Survey

All the members of the Society were reached by e-mail. Each member was given an alphanumeric code that prevented any member from completing the questionnaire twice. Members who did not complete the questionnaire were called back two more times (three times in total).

2.4 | Study preparation and ethics considerations

The preparation of the questionnaire took place through group meetings between the authors who also tried to fill out the test questionnaires.

Anonymity was maintained through the use of an alphanumeric code.

2.5 | Test of reliability

A test-retest analysis was performed on the questionnaire 1 week apart for 21 members of the SIdP. The k-statistics for qualitative variables and the intraclass correlation coefficient for quantitative variables were used as measures for intra-rater agreement. Landis & Koch criteria were used for interpretation of the coefficients (Landis & Koch, 1977). The results of the reliability test were reported in Table 1. Only cone beam computed tomography of item 8, item 15, and advanced reconstructive bone surgery in the edentulous areas

TABLE 1 Reliability of the questionnaire. Test–retest on 21 subjects

Variable	K-statistic
Sex	1.0
Age	1.0 ^a
DDS	1.0
MD	1.0
MD, DDS	1.0
Specialists in Periodontology	0.88
Specialists in Oral Surgery	1.0
PhD	0.88
Members	0.97
Periodontology practice	1.0
Implantology practice	1.0
Oral surgery practice	0.70
Prosthodontic practice	1.0
Restorative practice	0.88
Endodontic practice	0.69
Orthodontic practice	1.0
Years Periodontology practice	1.0 ^a
1. Skills of your team are adequate to treat complex clinical cases?	0.64
2. Who should be the team leader?	0.68
3. Time of motivation during non-surgical periodontal therapy	0.77 ^a
4. Time of non-surgical periodontal mechanical instrumentation	0.93 ^a
5. Periodontal non-surgical instrumentation mode	0.80
6. Do you use systemic antibiotic therapy in addition to subgingival instrumentation?	0.96 ^a
7. At what time of causal therapy do you use systemic antibiotics?	0.63
8. Further diagnostic examinations to organize treatment plane: "Panoramic radiograph"	0.69
"Cone Beam Computed Tomography"	0.33
"Lateral cephalogram"	0.90
"Diagnostic wax-up"	0.69
9. How do you achieve aesthetics?	1.0
10. Criteria to propose the extraction of periodontally compromised teeth: "Residual periodontium"	0.88
"Root anatomy"	0.63
"Hypermobility"	1.0
"Strategic value"	0.62
"Attachment loss"	0.67
11. When do you propose final treatment plan? "Immediately after diagnostic phase"	0.43
12. How do you manage dental hypermobility? "Splinting before non-surgical periodontal therapy"	0.81

(Continues)

TABLE 1 (Continued)

Variable	K-statistic
"Occlusal adjustment before non-surgical periodontal therapy"	0.60
"Occlusal adjustment after non-surgical periodontal therapy"	0.70
"Splinting after non-surgical periodontal therapy"	0.90
"At re-evaluation of non-surgical periodontal therapy"	0.69
13. How many times have you included orthodontic treatment in the rehabilitation project?	0.72
14. In unresponsive sites to non-surgical therapy (PD > 5 mm + infrabony defect) what do you usually do?	0.90
15. In presence of important dental migration, when do you carry out orthodontic treatment?	0.39
16. If resolution of masticatory dysfunction requires dental implants, when planning its insertion?	0.88
17. Which of the following is your operating sequence to restore chewing function by means of a fixed prosthesis?	0.44
18. In which clinical situations do you decide to extract all the residual dental elements and propose a rehabilitation on 4–6 implants with immediate load? "When the distribution of residual teeth does not allow their use as prosthetic abutments"	0.63
"When the distribution of residual teeth requires the need to perform advanced reconstructive bone surgery in the edentulous areas "	0.36
"When the patient has risk factors (smoking, diabetes) and need for advanced surgery"	0.46
"When the patient requires a quick treatment and with limited costs"	0.64
"When the patient is elderly"	1.0

^aICC: Intraclass correlation coefficient.

of item 18 showed a fair agreement. Only item 11, occlusal adjustment of item 12, item 17, and risk factor of item 18 achieved a moderate agreement. All the other items presented substantial or almost perfect agreement.

2.6 | Statistical analysis

Descriptive statistics were performed using median and interquartile interval for ordinal data, and frequency and percentage for qualitative data. Comparison between ordinary members (OMs) versus active and certified members (ACMs) and comparison between members with at least 10 years of experience in periodontology (Ov10) and members with less than 10 years of experience in periodontology (Un10) were performed. Fisher exact test was used for dichotomous variables (e.g., gender), chi-square was used for qualitative variable (e.g., item 9: objective), and Mann–Whitney test was used for ordinal variable (e.g., item 3: minutes of motivation). In case of the chi-square test with cells count under 5 in questions with

three answers, a sensitivity Fisher exact test was performed merging the cells with lower frequencies. In case of questions with more than three answers, a sensitivity chi-square test was performed deleting the answers with cells count under 5.

3 | RESULTS

3.1 | Respondent characteristics

In total, the respondents to the questionnaire were 324 out of 1362 (response rate of 24%). They were 270 males and 54 females. Sixteen were under 30 years old, 49 between 30 and 39 years, 62 between 40 and 49 years, 116 between 50 and 59, and 81 60 years or older. Active member respondents were 63 out of 124 (response rate of 51%); certificate member respondents were 17 out of 36 (47%). Therefore, active and certificated member (ACM) respondents were 80 out of 160 (response rate of 50%). Ordinary and junior member (OM) respondents were 244 out of 1202 (response rate of 20%).

3.2 | Ordinary members versus active and certified members

Characteristics of the OMs and ACMs were reported in Table 2. Between the two groups, there were statistically significant differences in rates of those who hold an MD DDS, specialization in Periodontology and who are practicing other disciplines such as Prosthodontics, Restorative Dentistry, Endodontics, and Orthodontics. ACM group included more clinicians who hold an

MD DDS, a certificate in Periodontology, who claimed to practice Periodontology for a longer period of time, and who earned a PhD compared to the OM group. On the contrary, OM group included greater number of clinicians who practiced also other disciplines such as Prosthodontics, Restorative Dentistry, Endodontics, and Orthodontics.

The statistics regarding the collected answers to the items of the questionnaire on patients with stage IV periodontitis for the two groups (OMs vs ACMs) were reported in Table 3. Between the two groups, there were statistically significant differences for items #1, 3, 4, 5, 6, 7, 13, 14, and 17. In particular, ACMs more often reported their teams hold adequate skills to manage those advanced cases. Step I-II periodontal therapy including motivation and supra and subgingival instrumentation required more time for the ACMs compared to OMs. The use of antibiotics was also different between the ACMs and OM groups. ACMs used antibiotics less frequently, and in case of their use, they were prescribed at the last session of non-surgical therapy. Furthermore, ACMs used different strategies for root instrumentation and not responsive sites after step II therapy were more often treated with surgery compared to OMs. Significantly ACM group included orthodontic treatment more often than OMs and in addition, treatment sequence differed between ACMs and OMs.

3.3 | Members with at least 10 years of experience in periodontology (Ov10) versus members with less than 10 years (Un10) in periodontology

There were 84 respondents Un10 and 240 respondents Ov10. Characteristics of the group Un10 and Ov10 are reported in Table 4.

Variable	OMs N = 244	ACMs N = 80	p-value
Sex (female)	40 (16%)	14 (17%)	0.8630*
Age (median years)	40–49	40–49	0.1280 [#]
DDS	182 (75%)	56 (70%)	0.4661*
MD	67 (27%)	24 (30%)	0.6990*
MD, DDS	32 (13%)	21 (26%)	0.0086*
Specialists in periodontology	16 (7%)	28 (35%)	<0.0001*
Specialists in oral surgery	21 (9%)	4 (5%)	0.3456*
PhD	13 (5%)	11 (14%)	0.0237*
Periodontology practice	224 (92%)	80 (100%)	0.0054*
Implantology practice	196 (80%)	67 (85%)	0.4103*
Oral surgery practice	180 (74%)	53 (66%)	0.1998*
Prosthodontic practice	181 (74%)	36 (45%)	<0.0001*
Restorative practice	140 (57%)	19 (24%)	<0.0001*
Endodontic practice	116 (48%)	13 (16%)	<0.0001*
Orthodontic practice	24 (10%)	1 (1%)	0.0080*
Years Periodontology practice (median)	<10	≥ 10	<0.0001[#]

TABLE 2 Characteristics of the ordinary members (OMs) and active/certificate members (ACMs)

Note: In bold: statistically significant values.

Abbreviations: OMs, Ordinary members; ACMs, Active/certificate members*; Fisher exact test;[#]: Mann-Whitney U-test.

TABLE 3 Answers to the items of the questionnaire on patients with stage IV periodontitis for the two groups: OMs vs ACMs

Variable	OMs N = 244	ACMs N = 80	p-value
1. Skills of your team are adequate to treat complex clinical cases? "Yes"	191 (78%)	79 (99%)	0.0001^ξ
"No"	21 (9%)	0 (0%)	
"Don't know"	32 (13%)	1 (1%)	
2. Who should be the team leader? "All"	154 (63%)	46 (58%)	0.6641^ξ
"Periodontist"	76 (31%)	29 (36%)	
"Prosthodontist"	14 (6%)	5 (6%)	
3. Time of motivation during non-surgical periodontal therapy (median minutes)	30	45	0.0004[#]
4. Time of non-surgical periodontal mechanical instrumentation (median minutes)	120	180	0.0011[#]
5. Periodontal non-surgical instrumentation mode: "Quadrant"	66 (27%)	20 (25%)	0.0001^ξ
"Supragingival + quadrant"	110 (45%)	29 (36%)	
"Full mouth disinfection"	58 (24%)	15 (19%)	
"Other techniques"	10 (4%)	16 (20%)	
6. Do you use systemic antibiotic therapy in addition to subgingival instrumentation? (median) "Yes"	10–24%	0–9%	0.0073[#]
7. At what time of causal therapy do you use systemic antibiotics? "Before"	74 (30%)	12 (15%)	<0.0001^ξ
"At first session"	82 (34%)	20 (25%)	
"At last session"	15 (5%)	20 (15%)	
"At re-evaluation"	73 (30%)	20 (25%)	
8. Further diagnostic examinations to organize treatment plane: "Panoramic radiograph"	136 (56%)	38 (47%)	0.2449*
"Cone Beam Computed Tomography"	135 (55%)	45 (56%)	0.8977*
"Lateral cephalogram"	49 (20%)	20 (25%)	0.3493*
"Diagnostic wax-up"	141 (58%)	52 (65%)	0.2942*
9. How do you achieve aesthetics? "Safeguarding natural teeth"	54 (22%)	20 (25%)	0.8343^ξ
"With implant therapy"	5 (2%)	2 (2%)	
"Considering patient expectations"	185 (76%)	58 (73%)	
10. Criteria to propose the extraction of periodontally compromised teeth: "Residual periodontium"	122 (50%)	39 (49%)	0.8978*
"Root anatomy"	82 (34%)	21 (26%)	0.2685*
"Hypermobility"	69 (28%)	23 (29%)	1.0*
"Strategic value"	156 (64%)	56 (70%)	0.3459*
"Attachment loss"	48 (20%)	14 (17%)	0.7449*
11. When do you propose final treatment plan? "Immediately after diagnostic phase"	4 (2%)	3 (4%)	0.3727^ξ
"Immediately after non-surgical periodontal therapy"	1 (0%)	1 (1%)	
"At re-evaluation of non-surgical periodontal therapy"	98 (40%)	34 (42%)	
"Three months after non-surgical periodontal therapy"	73 (30%)	27 (34%)	
"Six months after non-surgical periodontal therapy"	68 (28%)	15 (19%)	
12. How do you manage dental hypermobility? "Splinting before non-surgical periodontal therapy"	116 (48%)	37 (46%)	0.8976*
"Occlusal adjustment before non-surgical periodontal therapy"	119 (49%)	35 (44%)	0.4426
"Occlusal adjustment after non-surgical periodontal therapy"	77 (32%)	34 (42%)	0.0790*
"Splinting after non-surgical periodontal therapy"	102 (42%)	38 (47%)	0.4354*
"At re-evaluation of non-surgical periodontal therapy"	130 (53%)	49 (61%)	0.2442*

(Continues)

TABLE 3 (Continued)

Variable	OMs N = 244	ACMs N = 80	p-value
13. How many times have you included orthodontic treatment in the rehabilitation project? (median)	25-49%	25-49%	0.0384[#]
14. In unresponsive sites to non-surgical therapy (PD > 5 mm + infrabony defect) what do you usually do? "Subgingival instrumentation in any case"	73 (30%)	11 (14%)	0.0142[§]
"Subgingival instrumentation in some case"	74 (30%)	33 (41%)	
"Surgical therapy directly"	83 (34%)	34 (43%)	
"Tooth extraction based on its strategic value"	9 (4%)	0 (0%)	
"None of the above"	5 (2%)	2 (2%)	
15. In presence of important dental migration, when do you carry out orthodontic treatment? "After non-surgical therapy"	39 (16%)	14 (17%)	0.1493[§]
"After resolving suprabony pockets"	31 (13%)	12 (15%)	
"After resolving infrabony pockets"	128 (52%)	42 (52%)	
"Regardless characteristics of the pockets"	19 (8%)	10 (13%)	
"Avoid orthodontics"	27 (11%)	2 (3%)	
16. If resolution of masticatory dysfunction requires dental implants, when planning its insertion? "After non-surgical therapy"	21 (9%)	6 (7%)	0.9250[§]
"After solving both suprabony and infrabony pockets"	194 (80%)	64 (80%)	
"Only after solving deep infrabony pockets"	28 (11%)	10 (13%)	
"I avoid implant treatment"	1 (0%)	0 (0%)	
17. Which of the following is your operating sequence to restore chewing function by means of a fixed prosthesis?	71 (29%)	32 (40%)	0.0340[§]
"A - B - C - D"			
"B - A - C - D"	7 (3%)	6 (7%)	
"C - A - B - D"	6 (2%)	4 (5%)	
"E - A - B - C - D"	119 (49%)	26 (32%)	
"E - F - A - B - C - D"	41 (17%)	12 (15%)	
18. In which clinical situations do you decide to extract all the residual dental elements and propose a rehabilitation on 4-6 implants with immediate load?	176 (72%)	51 (64%)	0.1619*
"When the distribution of residual teeth does not allow their use as prosthetic abutments"			
"When the distribution of residual teeth requires the need to perform advanced reconstructive bone surgery in the edentulous areas"	63 (26%)	16 (20%)	0.3681*
"When the patient has risk factors (smoking, diabetes) and need for advanced surgery"	13 (5%)	7 (9%)	0.2874*
"When the patient requires a quick treatment and with limited costs"	70 (29%)	16 (20%)	0.1455*
"When the patient is elderly"	21 (9%)	2 (2%)	0.0789*

Note: In bold: statistically significant values.

Abbreviations: OMs, Ordinary members; ACMs, Active/certificate members[§]; chi-square test; #: Mann-Whitney U-test; *: Fisher's exact test; A: Resolution of pockets; B: temporary implant support to stabilize the occlusion; C: orthodontic treatment; D: definitive prosthesis; E: splinting; F: removable prostheses.

Ov10 members were older compared to Un10. Between the two groups, there were statistically significant differences in rates of gender, degree (DDS, MD, MD DDS), and post-graduate education (specialized in Periodontology, ACM, Implantology, Oral surgery, Restorative, and Endodontic practices).

The statistics regarding the answers to the questionnaire on stage IV periodontitis patients for the two groups (Un10 vs Ov10) were reported in Table 5. The two groups were statistically different

for items 1, 3, 4, 8, 15, and 18. In particular, those who belong to Ov10 group more often thought their team is skilled, they dedicated more time to motivation and instrumentation, and used more often CBCT, lateral cephalogram, and wax-up in the diagnostic phase. Un10 group more often avoided the use of orthodontic therapy. In addition, the two groups differed when the option of full mouth extraction followed by dental implants insertion with immediate loading was considered.

TABLE 4 Characteristics of the Un10 members and Ov10 members

Variable	Un10 N = 84	Ov10 N = 240	p-value
Sex (female)	25 (30%)	29 (12%)	0.0005*
Age (median years)	30–39	50–59	<0.0001 [#]
DDS	76 (90%)	162 (67%)	<0.0001*
MD	9 (11%)	82 (34%)	<0.0001*
MD, DDS	5 (6%)	48 (20%)	<0.0001*
Specialists in Periodontology	16 (7%)	28 (35%)	<0.0001*
Specialists in Oral Surgery	10 (12%)	34 (14%)	0.7127*
PhD	2 (2%)	22 (9%)	0.0507*
ACM	10 (12%)	70 (29%)	0.0012*
Implantology practice	52 (62%)	211 (88%)	<0.0001*
Oral surgery practice	52 (62%)	181 (75%)	0.0236*
Prosthetic practice	52 (62%)	165 (69%)	0.2814*
Restorative practice	59 (70%)	100 (42%)	<0.0001*
Endodontic practice	52 (62%)	77 (32%)	<0.0001*
Orthodontic practice	10 (12%)	15 (6%)	0.0982*

Note: Un10 members: Members with less than 10 years of experience in periodontology; Ov10 members: Members with at least 10 years of practice in periodontology; *: Fisher's exact test; [#]: Mann-Whitney U-test; ACM: active/certificate member.

In **bold**: statistically significant values.

3.4 | Sensitivity analysis

For the comparison between OMs and ACMs, the sensitivity analysis was performed for items 1, 9, 11, and 14 of the questionnaire. The results are similar to the main analysis. For the comparison between Ov10 and Un10, the sensitivity analysis was performed for items 1, 5, 9, 11, and 14 of the questionnaire. The results are similar to the main analysis, except from item 11. In the sensitivity analysis, without the answers “Immediately after diagnostic phase” and “Immediately after non-surgical periodontal therapy,” the p-value is significant $P = 0.0391$ while it was insignificant in the main analysis $p = 0.0845$.

4 | DISCUSSION

The clinical management of stage IV periodontitis is a great challenge for the complex diagnostic-therapeutic process and for multidisciplinary skills required. While guidelines for the clinical management and treatment of stage I-III periodontitis have been recently published (Chen et al., 2021; Sanz et al., 2020), at the time this questionnaire was administered, guidelines for the management of stage IV periodontitis have not been published yet.

The objective of this survey was to investigate on the differences in the decision-making process and in the management of stage IV periodontitis patients among trained clinicians from various backgrounds within the SidP.

Several diagnostic-therapeutic approaches and clinical decisions were reported among those who belong to different SidP member

categories and who had different level of experience in clinical periodontology.

Not surprisingly about 9% of the OMs and 17% of Un10 reported not to have specific skills to deal with those complex clinical cases thus confirming that treating stage IV periodontitis patients is a real challenge.

Oral hygiene instructions (OHI) and patient motivation to increase knowledge and awareness is an integral part of step I and II periodontal treatment guidelines (Sanz et al., 2020) and also should be reinforced during all stages of therapy (Carra et al., 2020; Tonetti et al., 2015). A recent two-year randomized clinical trial compared the efficacy of four different methods for enhancing oral hygiene motivation in 100 healthy or periodontitis subjects (Giani et al., 2021). The mean total time requested for standard oral hygiene instruction was 44 min (Giani et al., 2021). This time raised to 71 min when a brief motivational interviewing was added (Giani et al., 2021). This crucial step may be even more important for stage IV periodontitis patients in which dental migration, severe attachment loss, and loss of posterior support could make standard oral hygiene maneuvers even more difficult to be carried out. In this survey, ACMs and Ov10 members devoted more time to home care instructions and motivation during non-surgical periodontal therapy. The medians were 45 min for ACMs and Ov10 members versus 30 min for the OMs and Un10 members. Similarly, the instrumentation time was greater for ACMs and Ov10 members.

Non-surgical therapy was carried out with different modalities between OMs and ACMs. In particular, ACMs used less frequently quadrant-wise or full mouth disinfection approaches in stage IV periodontitis patients. Instead, ACMs used a more diversified and

TABLE 5 Answers to the items of the questionnaire on patients with stage IV periodontitis for the two groups: Un10 vs Ov10

Variable	Under 10 N = 84	Over 10 N = 240	p-value
1. Skills of your team are adequate to treat complex clinical cases?	58 (69%)	212 (88%)	<0.0001[‡]
“Yes”			
“No”	14 (17%)	7 (3%)	
“Don't know”	12 (14%)	21 (9%)	
2. Who should be the team leader? “All”	50 (59%)	150 (62%)	0.8836[‡]
“Periodontist”	29 (35%)	76 (32%)	
“Prosthodontist”	5 (6%)	14 (6%)	
3. Time of motivation during non-surgical periodontal therapy (median minutes)	30	45	<0.0001[#]
4. Time of non-surgical periodontal mechanical instrumentation (median minutes)	120	150	0.0011[#]
5. Periodontal non-surgical instrumentation mode: “Quadrant”	17 (20%)	69 (29%)	0.0894[‡]
“Supragingival + quadrant”	42 (50%)	97 (40%)	
“Full mouth disinfection”	22 (26%)	51 (21%)	
“Other techniques”	3 (4%)	23 (10%)	
6. Do you use systemic antibiotic therapy in addition to subgingival instrumentation? (median) “Yes”	10–24%	10–24%	0.2838[#]
7. At what time of causal therapy do you use systemic antibiotics? “Before”	27 (32%)	59 (25%)	0.3753[‡]
“At first session”	24 (29%)	86 (36%)	
“At last session”	11 (13%)	24 (10%)	
“At re-evaluation”	22 (26%)	71 (29%)	
8. Further diagnostic examinations to organize treatment plane: “Panoramic radiograph”	46 (55%)	128 (53%)	0.8990*
“Cone Beam Computed Tomography”	31 (37%)	149 (62%)	<0.0001*
“Lateral cephalogram”	9 (11%)	60 (25%)	0.0052*
“Diagnostic wax-up”	34 (40%)	159 (66%)	<0.0001*
9. How do you achieve aesthetics? “Safeguarding natural teeth”	13 (15%)	61 (25%)	0.1747[‡]
“With implant therapy”	2 (2%)	5 (2%)	
“Considering patient expectations”	69 (82%)	174 (73%)	
10. Criteria to propose the extraction of periodontally compromised teeth: “Residual periodontium”	38 (45%)	123 (51%)	0.3760*
“Root anatomy”	30 (36%)	73 (30%)	0.4144*
“Hypermobility”	29 (35%)	63 (26%)	0.1610*
“Strategic value”	56 (67%)	156 (65%)	0.8940*
“Attachment loss”	15 (18%)	47 (20%)	0.7449*
11. When do you propose final treatment plan? “Immediately after diagnostic phase”	3 (4%)	4 (2%)	0.0845[‡]
“Immediately after non-surgical periodontal therapy”	0 (0%)	2 (1%)	
“At re-evaluation of non-surgical periodontal therapy”	43 (51%)	89 (37%)	
“Three months after non-surgical periodontal therapy”	18 (21%)	82 (34%)	
“Six months after non-surgical periodontal therapy”	20 (24%)	63 (26%)	
12. How do you manage dental hypermobility? “Splinting before non-surgical periodontal therapy”	35 (42%)	118 (49%)	0.2549*
“Occlusal adjustment before non-surgical periodontal therapy”	39 (46%)	115 (48%)	0.8991*
“Occlusal adjustment after non-surgical periodontal therapy”	26 (31%)	85 (35%)	0.5056*
“Splinting after non-surgical periodontal therapy”	44 (52%)	96 (40%)	0.0553*
“At re-evaluation of non-surgical periodontal therapy”	39 (46%)	140 (58%)	0.0740*

TABLE 5 (Continued)

Variable	Under 10 N = 84	Over 10 N = 240	p-value
13. How many times have you included orthodontic treatment in the rehabilitation project? (median)	25–49%	25–49%	0.2787 [#]
14. In unresponsive sites to non-surgical therapy (PD > 5 mm + infrabony defect) what do you usually do? "Subgingival instrumentation in any case"	20 (24%)	64 (27%)	0.2379 ^{&}
"Subgingival instrumentation in some case"	34 (40%)	73 (30%)	
"Surgical therapy directly"	24 (29%)	93 (39%)	
"Tooth extraction based on its strategic value"	4 (5%)	5 (2%)	
"None of the above"	2 (2%)	5 (2%)	
15. In presence of important dental migration, when do you carry out orthodontic treatment? "After non-surgical therapy"	10 (12%)	43 (18%)	0.0049 ^{&}
"After resolving suprabony pockets"	10 (12%)	33 (14%)	
"After resolving infrabony pockets"	38 (45%)	132 (55%)	
"Regardless characteristics of the pockets"	11 (13%)	18 (7%)	
"Avoid orthodontics"	15 (18%)	14 (6%)	
16. If resolution of masticatory dysfunction requires dental implants, when planning its insertion? "After non-surgical therapy"	5 (6%)	22 (9%)	0.3010 ^{&}
"After solving both suprabony and infrabony pockets"	68 (81%)	190 (79%)	
"Only after solving deep infrabony pockets"	10 (12%)	28 (12%)	
"I avoid implant treatment"	1 (1%)	0 (0%)	
17. Which of the following is your operating sequence to restore chewing function by means of a fixed prosthesis?	31 (37%)	7	0.6118 ^{&}
"A – B – C – D"		72 (30%)	
"B – A – C – D"	2 (2%)	11 (4%)	
"C – A – B – D"	3 (4%)	7 (3%)	
"E – A – B – C – D"	33 (39%)	112 (47%)	
"E – F – A – B – C – D"	15 (18%)	38 (16%)	
18. In which clinical situations do you decide to extract all the residual dental elements and propose a rehabilitation on 4–6 implants with immediate load? "When the distribution of residual teeth does not allow their use as prosthetic abutments"	54 (64%)	173 (72%)	0.2128 [*]
"When the distribution of residual teeth requires the need to perform advanced reconstructive bone surgery in the edentulous areas"	29 (35%)	50 (20%)	0.0176[*]
"When the patient has risk factors (smoking, diabetes) and need for advanced surgery"	3 (4%)	17 (7%)	0.3035 [*]
"When the patient requires a quick treatment and with limited costs"	15 (18%)	71 (30%)	0.0440[*]
"When the patient is elderly"	5 (6%)	18 (7%)	0.8064 [*]

Note: Un10 members: Members with less than 10 years of experience in periodontology; Ov10 members: Members with at least 10 years of practice in periodontology; [&]: chi-square test; [#]: Mann–Whitney U-test; ^{*}: Fisher's exact test; A: Resolution of pockets; B: temporary implant support to stabilize the occlusion; C: orthodontic treatment; D: definitive prosthesis; E: splinting; F: removable prostheses.

In bold: statistically significant values.

personalized strategies to carry out non-surgical therapy for these complex cases.

Microbial resistance as a consequence of the broad use of antibiotics is emerging as a public health issue and their routine use as an adjunct to subgingival debridement in periodontitis patients is therefore not recommended (Sanz et al., 2020). Based on the available evidence, however, antibiotics may be considered for special patient categories (e.g., generalized periodontitis Stage III in young adults) (Sanz et al., 2020) while it is unclear if antibiotics should be

used in stage IV periodontitis patients. This uncertainty also resulted from the responses to the questionnaire. It appears that ACMs use antibiotics less frequently and even differently than OMs. We may speculate that ACMs have readily accepted the indication of the recent guidelines for the treatment of stage I–III periodontitis (Sanz et al., 2020).

In respect to the diagnostic process, more experienced clinician (Ov10) requested a greater number of information (CBCT, lateral cephalogram, wax-up) compared to Un10 group. It appears

that those who have practiced periodontology for several years are more familiar with a multidisciplinary diagnostic approach for stage IV periodontitis that requires complex rehabilitation because of masticatory dysfunction. More experienced operators resulted to be more aware of the need of a comprehensive diagnosis including prosthetic, orthodontic, wax-up, and implant evaluation to draw an appropriate treatment plan (Sailer et al., 2022).

Significantly, a higher percentage of Un10 members completely avoid to involve orthodontic treatment in the management of stage IV periodontitis patients. While two recent systematic reviews, of limited and poor-quality evidences, have indicated that orthodontic treatment might be associated with small improvements of periodontal parameters in periodontally treated teeth (Kloukos et al., 2021; Papageorgiou et al., 2021), orthodontic therapy in these cases may be essential in reestablishing an adequate plane of occlusion and correct pathological flaring and drifting of the teeth. A recent study, using an Index for orthodontic treatment needs, showed that patients affected by severe periodontitis frequently required orthodontic treatment (Meyer-Marcotty et al., 2021). As a matter of fact, in these type of patients “flaring out” of the maxillary anterior teeth and pathological migration of posterior teeth are frequently distinctive signs of the disease. In patients over 40 years of age the higher the degree of periodontal breakdown was, the more severe were overjet and overbite and the need of orthodontic therapy (Meyer-Marcotty et al., 2021).

Another notable difference between ACMs and OMs regarded the management of sites that have not responded adequately to non-surgical therapy. OMs more often reported to repeat the subgingival instrumentation, while ACMs repeated the subgingival instrumentation only in some cases and more often proposed surgical therapy. However, the approach to not responsive sites seems to be rather heterogeneous within the ACM group, too. These differences may be explained by taking into considerations other factors not mentioned in the questionnaire such as severity of residual pocket depth, type of the associated osseous defect, and patient risk profile.

The sequence of treatment, when dealing with stage IV periodontitis cases, is complex because the goals of therapy are not only related to control periodontitis but also to reach a functional and esthetic rehabilitation of the patient. Several sequences of treatment were proposed in the item #17 of the questionnaire and the answers differed between ACMs and OMs. OMs started their treatment more often with splinting while ACMs more frequently started their treatment with pocket resolution.

In case of unfavorable distribution of residual teeth and when advanced reconstructive bone surgery was required in the edentulous areas for implant placement, Un10 group more frequently proposed full mouth teeth extraction followed by the rehabilitation on 4–6 implants with immediate prosthetic loading. Advanced reconstructive bone surgery to allow implant placement in atrophic edentulous areas has been shown to be an effective procedure although strong evidence focusing on stage IV periodontitis cases are lacking (Jepsen et al., 2019). However, managing those advanced procedures requires a high degree of surgical competence, adequate

training, and a great deal of experience. It is understandable, therefore, that less experienced clinicians (Un10 group) tended to use alternative approaches that they feel more able to control better. On the contrary, Ov10 group more frequently proposed the extraction of all the residual teeth and rehabilitation on 4–6 implants with immediate loading when the patient requires a quick treatment and with limited costs.

The results of this survey should be interpreted in light of the limitations of the methodology used as the administered questionnaire may not have been able to cover all issues relevant to the management of stage IV periodontitis patients. Furthermore, it should be remembered that only SIdP members were taken into consideration and only a portion of those replied to the questionnaire. Therefore, this sample may not be representative of the entire membership population, but most likely involves the most motivated members or those who are most interested in the treatment of this type of patients. In addition, not all the members of SIdP practiced periodontology. However, this type of survey may help scientific societies to design continuing education programs to increase the level of knowledge and competence of clinicians in the management of stage IV periodontitis patient thus promoting an interdisciplinary approach.

5 | CONCLUSIONS

Several differences were reported between the active members and the ordinary members and between the Under 10 and the Over 10 members in clinical decision-making and management of stage IV periodontitis patients. More experienced members spent more time in step I and II of periodontal therapy, used more diagnostic tools, and performed more often surgery and orthodontics in the treatment of stage IV periodontitis patients.

AUTHOR CONTRIBUTIONS

Mauro Merli: Resources; supervision; visualization; writing – original draft; writing – review and editing. **Adriano Fratini:** Resources; supervision; visualization; writing – original draft; writing – review and editing. **Nicola Marco Sforza:** Conceptualization; methodology; writing – review and editing. **Luca Landi:** Conceptualization; writing – original draft; writing – review and editing. **Umberto Pagliaro:** Conceptualization; methodology; writing – original draft; writing – review and editing. **Lorenzo Franchi:** Conceptualization; methodology; writing – original draft; writing – review and editing. **Michele Nieri:** Methodology; Data curation; Formal Analysis.

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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APPENDIX 1

Figure 1. Questionnaire on stage IV Periodontitis.

Survey on Stage IV Periodontitis

Dear colleague,

we are carrying out a study on the most severe form of Periodontal Disease, Stage IV Periodontitis with the presence of less than 20 teeth and with masticatory dysfunction (link to the EFP Guidelines 2020 Sanz and Coll.). In particular, we would like to investigate what your approach is regarding the diagnostic pathway, prognostic evaluation and operating sequence of therapy of this condition. We kindly ask you to answer to the following questions in order to have useful information for this survey whose results will be described in the next XX National Congress SIdP 2022.

To answer the questionnaire simply click on the link and it will take only few minutes to complete it.

The SIdP guarantees the anonymity and confidentiality of your answers that will be used only for statistical purposes.

You will find the questionnaire at the following link:

Sex

- a) Male
- b) Female

Age

- a) ≤29 years
- b) 30-39 years
- c) 40-49 years
- d) 50-59 years
- e) ≥60 years

Qualification (multiple answers are allowed):

- a) Degree in Dentistry
- b) Degree in Medicine and Surgery
- c) Medical degree with speciality in dentistry
- d) Specialties in Periodontology
- e) Specialty in Oral Surgery
- f) PhD

You are registered with the SIdP as a member:

- a) Active
- b) Certificate
- c) Ordinary
- d) Junior Ordinary

Which of the following specialties you normally deal with (multiple answers are allowed):

- a) Periodontology
- b) Implantology
- c) Surgery
- d) Prosthodontics
- e) Restorative Dentistry
- f) Endodontics
- g) Orthodontics

How many years have you been dealing with periodontology?

- a) < 10 years
- b) > 10 years
- c) > 20 years
- d) I don't deal with periodontology

For all the following questions, answer considering that we are referring to Stage IV periodontitis with the presence of less than 20 remaining teeth (10 opposing pairs), high dental hypermobility of one or more teeth, severe involvement of molar bifurcations and masticatory dysfunction.

1. Do you think that the team in which you work has the specific skills to deal with those complex clinical cases?

- a) Yes
- b) No
- c) I don't know

2. Who do you think should be the team leader for a correct coordination of the diagnostic-therapeutic path?

- a) the periodontist
- b) the prosthodontist
- c) the implantologist
- d) the orthodontist
- e) all the team that shares responsibilities

3. How much time do you devote overall to education and motivation to home oral hygiene during non-surgical periodontal therapy in such severe cases?

- a) 15 minutes
- b) 30 minutes
- c) 45 minutes
- d) 60 minutes
- e) over 60 minutes

4. How much time do you devote to mechanical instrumentation considering the presence of about 20 dental elements?

- a) 90 minutes
- b) 120 minutes
- c) 150 minutes
- d) 180 minutes
- e) over 180 minutes

5. How do you perform non-surgical periodontal therapy?

- a) Quadrant wise
- b) one supragingival session followed by quadrant wise instrumentation
- c) full mouth disinfection
- d) other techniques:

6. In addition to subgingival instrumentation, do you also use systemic antibiotic therapy?

- a) always or almost always (75-100% of the time)
- b) often (50-74% of the time)
- c) sometimes (25-49% of the time)
- d) rarely (10-24% of the time)

- e) never or almost never (0-9% of the time)
- 7. In the case of use of systemic antibiotic therapy at what time of causal therapy?**
- before the start
 - at the first session
 - at the last session
 - at the end of the professional instrumentation phase, as an adjunct therapy, after verifying the results of the causal phase in re-evaluation
- 8. In addition to probing before and after causal therapy, periapical Rx and study casts, what further diagnostic exams do you normally use to formulate the treatment plan?**
- Panoramic Radiograph (OPG)
 - Cone Beam Computed Tomography (CBCT)
 - Lateral and/or Posteroanterior Cephalogram
 - diagnostic wax-up
 - all the previous
 - none of the previous
- 9. During the diagnostic process, if the patient expresses high aesthetic demands you believe that it is easier to achieve this goal:**
- through an approach that safeguards the recovery of natural teeth
 - extracting natural teeth and replacing them with dental implants
 - considering the expectations, needs and constraints given by the patient
- 10. What are the two most important criteria used to propose the extraction of a periodontally compromised teeth (2 answers are possible):**
- the amount of residual periodontium
 - radicular anatomical features
 - dental hypermobility
 - the strategic value of the compromised tooth
 - loss of clinical attachment
- 11. When do you propose the final treatment plan to the patient? :**
- immediately after the diagnostic phase
 - immediately after non-surgical periodontal therapy
 - after re-evaluation of non-surgical periodontal therapy
 - 3 months after completion of non-surgical periodontal therapy
 - 6 months after completion of non-surgical periodontal therapy
- 12. How do you manage dental hypermobility (possible multiple answers):**
- splinting before non-surgical periodontal therapy
 - occlusal adjustment before non-surgical periodontal therapy
 - occlusal adjustment after non-surgical periodontal therapy
 - splinting after non-surgical periodontal therapy
 - re-evaluation after non-surgical periodontal therapy
- 13. How many times have you included orthodontic treatment in the rehabilitation project?**
- always or almost always (75-100% of the time)
 - often (50-74% of the time)
 - sometimes (25-49% of the time)
 - rarely (10-24% of the time)
 - never or almost never (0-9% of the time)
- 14. In sites that have not responded adequately to non-surgical therapy with residual pockets > 5 mm and radiographic infraosseous defects what do you usually do?**
- I repeat the subgingival instrumentation in any case
 - I repeat the subgingival instrumentation only in some cases
 - I propose surgical therapy directly
 - I propose the extraction of the tooth based on the strategic value
 - none of the above
- 15. In cases with important dental migrations when do you carry out orthodontic treatment?**
- after causal therapy
 - after reaching the goal of resolving over-axis pockets
 - after reaching the goal of resolving infraosseous pockets
 - regardless of the characteristics of infra or over-axis pockets
 - I avoid orthodontic treatment
- 16. In the event that the resolution of masticatory dysfunction involves the use of implants when making implant insertion?**
- after non-surgical periodontal therapy
 - after achieving the goal of resolving periodontal pockets regardless of the characteristics of the pockets (above or infraosseous)
 - only after solving the deep infraosseous pockets
 - I avoid implant treatment
- 17. Which of the following is your operating sequence to restore chewing function by means of a fixed prosthesis?**
- 1) resolution of pockets 2) temporary implant support to stabilize the occlusion, 3) orthodontic treatment, 4) definitive prosthesis
 - 1) temporary implant support to stabilize the occlusion, 2) resolution of pockets, 3) orthodontic treatment, 4) definitive prosthesis
 - 1) orthodontic treatment, 2) resolution of pockets, 3) temporary implant support to stabilize the occlusion, 4) definitive prosthesis
 - 1) splinting, 2) resolution of pockets, 3) temporary implant support to stabilize occlusion, 4) removal of splinting and orthodontic treatment, 5) definitive prosthesis
 - 1) splinting, 2) removable prosthesis, 3) resolution of pockets, 4) temporary implant support to stabilize occlusion, 5) orthodontic treatment, 6) definitive prosthesis
- 18. In which clinical situations do you decide to extract all the residual dental elements and propose a rehabilitation on 4-6 implants with immediate load? (possible multiple answers)**
- never
 - when the distribution of residual teeth does not allow their use as prosthetic abutments
 - when the distribution of residual teeth requires, for a correct aesthetic-functional restoration of the mouth, the need to perform advanced reconstructive bone surgery in the edentulous areas
 - when the patient has risk factors (smoking, diabetes) and need for advanced surgery
 - when the patient requires a quick treatment and with limited costs
 - when the patient is elderly