Initial extractions and tooth loss during supportive care in a periodontal population seeking comprehensive care


Abstract
Background/aims: This retrospective survey was aimed at determining the prevalence of tooth extractions and the dental pathologies associated with them during both the active and maintenance phase of periodontal therapy in a periodontal population seeking comprehensive dental care.
Methods: A total of 273 randomly selected subjects from the oral prophylaxis clinic of the University of Berne were included. All subjects had received comprehensive care consisting of periodontal and restorative treatment and participated in a supervised maintenance program for an average of 67±46 months (range 5 to 278 months). The population consisted of 39.6% current smokers and 27.8% previous smokers. 6.2% of the patients had gingivitis, 20.5% mild periodontitis, 48.4% moderate and 24.9% severe periodontitis. The average frequency of the recall visits was 4.4±1.5 appointments/year (range 1.7–12 appointments/year).
Results: Results indicated that 574 out of a total of 6503 teeth were extracted; 311 teeth were extracted during active therapy and 263 during the supportive periodontal care (SPC) phase of therapy. 46% of patients received tooth extractions as part of their active treatment and 41% during their participation in the secondary prevention program. In the subgroup whose treatment plan included extractions the average number was 2.5±1.6 teeth per patient. Likewise, the patients who received extractions during recall lost an average of 2.35±1.9 teeth per subject with an incidence of 0.4±0.37 teeth per patient per year. These data reinforce the concept that a minority of the population is responsible for the majority of tooth extractions, both during active therapy and SPC. Periodontal disease was the only pathology observed at 57% of the extracted teeth; while caries, endodontic pathology and technical problems in the absence of periodontitis were observed in 29% of cases.
Conclusions: These observations indicate that the rendered treatment was effective in the long-term maintenance of the dentition of these subjects and suggest that advanced periodontal disease represented the major cause of tooth loss in this population.

The major objectives of periodontal therapy are the control of periodontal infections, the resolution of the anatomical sequelae of the inflammatory driven tissue destruction, and the maintenance of a functional dentition for a lifetime. In recent years, the efficacy of various treatment modalities has been tested using measures such as reductions in bleeding on probing, changes in probing depths, changes in attachment levels, and/or changes in the remaining alveolar bone support (Knowles et al. 1979, Phlstrom et al. 1983, Lindhe et al. 1984, Kaldhal et al. 1996). More recently it has been pointed out that, even though the surrogate outcomes mentioned above may to a large extent be adequate descriptors of the periodontal disease process, the true outcome of peri-
odontal therapy remains tooth survival (Hajoei & DeRuen 1995).

In periodontal therapy, relevant evidence related to tooth survival is at least twofold: (i) tooth extraction during initial or active periodontal therapy; (ii) tooth loss during the supportive periodontal care program that should be instituted after the completion of active periodontal therapy.

In this respect, very little is known about the number, the prevalence and the causes of tooth extractions that are performed during active periodontal therapy. It is clear that many factors contribute to the clinical decision to include tooth extraction within the treatment of periodontal patients. Among these are disease severity at individual teeth, the extent of periodontal destruction within the dentition, the strategic value of a compromised tooth, aesthetics, and the predictability and the cost-benefit ratio of the available treatment options. Therefore, in spite of: (i) the demonstration that even teeth with an extremely reduced but healthy periodontium can function for a long time as part of specifically designed reconstructions (Nyman & Lindhe 1976); (ii) the recognition that the medium term prognosis of teeth with severe intrabony defects can be changed by reconstructive periodontal surgery (Cortellini et al. 1994, Cortellini et al. 1996); (iii) the documentation that teeth with furcation involvement can be successfully treated and maintained long term (Carnevale et al. 1991); extractions during active therapy remain an important option. Furthermore, teeth may need to be extracted during periodontal therapy for causes unrelated to periodontal disease such as unrestorable caries, recalcitrant endodontic lesions, and/or technical reconstructive problems.

Central to the current practice of periodontology is the demonstration that the sequential combination of various forms of periodontal therapy with periodic periodontal maintenance care can result in long-term improvements of periodontal outcome measures (Knowles et al. 1979, Pilhstrom et al. 1983, Lindhe & Nyman 1984, Lindhe et al. 1984, Ramfjord et al. 1987, Kaldhal et al. 1996). In a controlled clinical trial, Axellson and Lindhe (Axellson & Lindhe 1981) evaluated the significance of maintenance care following surgical periodontal therapy. In patients receiving regular maintenance care at 3-month intervals, the periodontal conditions at the majority of sites remained stable during the 6 years of observation; conversely, the control group that, following active periodontal therapy, was not maintained in a supervised program showed attachment loss of 2 mm at 50–70% of sites. Progression of treated periodontal disease in the absence of proper maintenance care has been confirmed in some retrospective evaluations (Kendt 1981, Becker et al. 1984).

In spite of the demonstrated clinical benefits of participation in a supportive periodontal care program (SPC), several investigations have indicated that, in private practice, only a minority of periodontal patients comply with the prescribed regimen (Wilson et al. 1984, Mendoza et al. 1991, Checchi et al. 1994, Demetriou et al. 1995), and that efforts to optimise compliance are only partly successful (Wilson et al. 1993).

The prevalence and the incidence of tooth loss during supportive periodontal care have been reported in several longitudinal investigations. A summary of the evidence reporting the incidence of tooth loss derived from a series of retrospective studies including a total of 1888 patients followed up for a minimum of 10 years, indicates an overall incidence of tooth loss in treated and well maintained periodontal populations of 0.11 teeth per patient per year (Hirschfeld & Wasserman 1978, McFall 1982, Goldman et al. 1986, Wood et al. 1989, McLeod et al. 1997). Furthermore, data have indicated that only a minority of patients attending a supportive care program will actually suffer from tooth loss after completion of periodontal therapy (Tonetti et al. 1998). This further supports the notion that the employed secondary prevention regimens are efficacious in decreasing the likelihood of tooth loss in the majority of subjects.

The aim of this investigation was to describe (i) the prevalence of tooth loss and (ii) the dental pathologies associated with extraction during active periodontal therapy and in the subsequent SPC period in a periodontal population who received comprehensive care at a University Clinic and was maintained in an individualised recall program.

Material and Methods

Experimental design

This was a retrospective longitudinal survey of tooth extraction during active periodontal therapy and tooth loss during the following supportive periodontal care interval. A representative sample of the patients attending the supportive periodontal care (SPC) program at the prophylaxis clinic of the Department of Periodontology and Fixed Prosthodontics of the University of Bern was randomly selected to participate in this investigation. The number of teeth present was determined at 3 time points: the initial consultation, the first SPC appointment following completion of active periodontal therapy, and the latest clinical session of the SPC. The clinical records were used as the source. Clinical diagnosis according to ADA case type was retrospectively performed by a single calibrated periodontist. All patients had received the required comprehensive dental care that included a cycle of periodontal therapy consisting of a minimum of patient motivation, oral hygiene instructions, and scaling and root planing.

Experimental population

Consecutive patients presenting for a SPC session between January and April 1995 were invited to participate in this study. Inclusion criteria were as follows:

(i) completion of active periodontal therapy at least 6 months previously and current participation in the SPC program; (ii) lack of a contributory medical history and in particular no medical diagnosis of diabetes mellitus or other recognised medical risk factors for periodontitis; (iii) availability of a complete clinical record including medical history, periodontal probing and diagnostic quality radiographs. 270 patients, 58% females, between 16 and 81 years of age (52±14) satisfied these criteria and agreed to participate in this study. The experimental population has been previously described in detail (Tonetti et al. 1998).

Periodontal therapy

The aim of the delivered periodontal therapy was improvement of oral hygiene practices, careful coronal and root debridement and reduction of pocket depths. To this end all patients had received at least a cycle of periodontal therapy consisting of oral hygiene instructions, scaling and root planing and access flap surgery as needed. Whenever performed, surgery consisted of repositioned flaps with no osseous recontouring (modified Wid-
man flaps). Following completion of the planned therapy, patients were placed in a SPC program with a dental hygienist.

Supportive periodontal care program
Each SPC session consisted of a 60-min appointment and included an initial diagnostic phase (update of medical history, evaluation of oral hygiene performance, dental diagnosis, periodontal probing, and BOP). This was followed by motivation and oral hygiene instructions. Instrumentation included supragingival debridement and prophylaxis with polishing paste of all sites and scaling and root planing of all bleeding pockets.

Tooth extraction
The number of teeth present at the different time points was recorded. Two experimental periods were defined by the completion of periodontal therapy: an initial active therapy phase and a subsequent maintenance phase. The dental pathologies associated with tooth extraction were determined using the clinical record as the source. Each tooth that was extracted was classified as having one or more of the following pathologies: periodontal disease, caries, endodontic problems, and technical failures (e.g. root fractures). If the associated pathologies were unclear, it was marked as unknown. Tooth loss data could be retrieved for 270 of the 273 randomly selected patients.

We also determined whether or not extracted teeth were prosthetic abutments or had single crowns. Presence of furcation involvement was also determined. The total time on the SPC program (TIME) was calculated in months, while the frequency of the SPC visits was obtained dividing TIME by the number of appointments. To assure a consistent evaluation of the cases, the initial periodontal diagnosis was retrospectively determined, by one of the investigators (VMC) on the basis of available radiographs and on the clinical records. Patients were classified according to the American Dental Association case type classification as suffering from gingivitis, mild, moderate or severe periodontitis.

Radiographic bone loss
Radiographic bone loss was estimated at the extracted teeth. On a parallel technique intraoral radiograph (Updegraffe 1951) the following anatomical landmarks were defined: the cemento-enamel junction (CEJ), the root apex and the apical extent of bone loss. The location of the CEJ was identified according to the criteria of Schae (Schae et al. 1959). The most coronal area where the periodontal ligament retained an even width was identified on the radiograph to indicate the most apical extension of bone loss (Björn et al. 1969). Bone loss was expressed as a % of the total root length.

Smoking status
Smoking status and history were determined by a self-administered mail-in questionnaire. Patients who failed to return the questionnaire were telephonically interviewed. The questionnaire collected information regarding to present or previous tobacco smoking habit (including cigarettes, cigars, and pipe), the duration (years) and the dose of the exposure (cigarettes/day), as well as the eventual date of cessation (Tonetti et al. 1998).

Data management and statistical analyses
Data were entered in a microcomputer and proofed for entry errors. The resulting database was locked and loaded in SAS format (Statistical Application Software, SAS Institute, Cary, NC) on the mainframe computer of the University of Bern. All calculations and analyses were performed using SAS Version 6.09. Descriptive statistics included calculation of averages and standard deviations. When data were not normally distributed medians and interquartile ranges (IQ range) were also reported. Significance of differences between groups was performed with unpaired parametric (normally distributed continuous variables) or non-parametric (non-normally distributed data or frequencies) tests. Comparisons within the same group were performed with paired tests. For all analyses, significance was set at 0.05.

Results
Initial extractions and tooth loss during recall in the experimental population
273 periodontal patients requiring comprehensive dental care received treatment and remained in a periodontal supportive care program for an average of 67±46 months (range 5 to 278 months). The population consisted of 39.6% current smokers and 27.8% previous smokers at the time of the smoking interview during the recall program. 6.2% of the patients had gingivitis (ADA case type 1), 20.5% mild periodontitis (ADA case type 2), 48.4% moderate and 24.9% severe periodontitis (ADA case type 3 and 4, respectively). The average frequency of the recall visits was 4.4±1.5 appointments/year (range 1.7–12 appointments/year).

At the cross-sectional evaluation during recall, these subjects presented with a total of 5929 teeth; this compares with the retrospective evaluation of the clinical records which showed that these patients presented with 6503 teeth at their initial examination. A total of 574 teeth were lost, 311 were extracted during the initial phase of treatment, and 263 were lost during the recall period. 90 (15.7%) were third molars, while 11 teeth (1.9%) were retained primary teeth. Third molars and retained primary teeth were excluded from further analyses.

299 extracted teeth were maxillary (88 incisors, 23 canines, 47 multi-rooted upper premolars, 35 single rooted upper premolars, and 106 molars), and 175 mandibular (35 incisors, 10 canines, 51 premolars and 79 molars).

Fig. 1 displays the pathologies associated with extraction of all teeth (during active treatment and maintenance care) with the exception of wisdom teeth and retained primary teeth. Advanced periodontal disease alone was associated with 57% of tooth extractions in this population; while periodontal disease combined with carious, endodontic, and/or technical problems
Table 1. Prevalence of various levels of radiographic bone loss at teeth extracted during active therapy or supportive care in the presence of periodontal pathology alone.

<table>
<thead>
<tr>
<th>Radiographic bone loss (%)</th>
<th>Teeth (%)</th>
</tr>
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<tbody>
<tr>
<td>bone loss &lt;50%</td>
<td>41%</td>
</tr>
<tr>
<td>50% ≤ bone loss ≤ 80%</td>
<td>44.4%</td>
</tr>
<tr>
<td>bone loss &gt;80%</td>
<td>14.6%</td>
</tr>
</tbody>
</table>

Table 2. Prevalence and average number of extractions (mean±SD) during active treatment in patients presenting with different ADA case types at baseline.

<table>
<thead>
<tr>
<th>ADA case type</th>
<th>N</th>
<th>Overall population (median, IQ range)</th>
<th>Prevalence (% patients)</th>
<th>Extractions patients* (median, IQ range)</th>
</tr>
</thead>
<tbody>
<tr>
<td>gingivitis</td>
<td>17</td>
<td>1.1±1.5 (0, 0–2)</td>
<td>43.75%</td>
<td>2.4±1.3 (2, 1.5–3.5)</td>
</tr>
<tr>
<td>mild periodontitis</td>
<td>56</td>
<td>0.6±1 (0, 0–1)</td>
<td>37.50%</td>
<td>1.7±1 (1, 1–2)</td>
</tr>
<tr>
<td>moderate periodontitis</td>
<td>131</td>
<td>1.3±1.9 (0, 0–2)</td>
<td>48.44%</td>
<td>2.8±1.8 (2.5, 1–3.75)</td>
</tr>
<tr>
<td>severe periodontitis</td>
<td>69</td>
<td>1.3±1.7 (0.5, 0–2)</td>
<td>50.00%</td>
<td>2.6±1.6 (2, 1–4)</td>
</tr>
</tbody>
</table>

* Average number of extractions in patients who experienced at least one extraction.

Table 3. Prevalence of problems in teeth extracted during active therapy or during the subsequent supportive periodontal care period; some teeth presented more than one problem.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Active therapy (%)</th>
<th>Supportive care (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>periodontal disease</td>
<td>76.6</td>
<td>64</td>
</tr>
<tr>
<td>endodontic pathology</td>
<td>16.4</td>
<td>12.8</td>
</tr>
<tr>
<td>caries</td>
<td>16.4</td>
<td>19</td>
</tr>
<tr>
<td>technical problems</td>
<td>14</td>
<td>27</td>
</tr>
</tbody>
</table>

The teeth extracted with periodontal disease as the only pathology had an average radiographic bone loss of 56±22%. The distribution of bone loss among these teeth is displayed in Table 1. The % of bone loss was 62±21% in extracted single rooted teeth and 49±20 in extracted multi-rooted teeth; among multi-rooted teeth extracted with periodontal pathology only, 75% had furcation involvement. In the population 35.5% of extracted teeth were prosthetic abutments.

Tooth extraction during active periodontal therapy

During active periodontal therapy, a total of 311 teeth were extracted. This represented 4.8% of the total number of teeth present at the baseline examination and corresponded to an average of 1.6±1.7 extractions per patient. Initial extractions, however, were performed in only 46% of patients. If extractions were performed their average was 2.5±1.6 extractions per patient (with a range of 1 to 9, a median of 2, and an IQ range of 1 to 3).

Table 2 displays the average number of teeth extracted during initial therapy in patients with different ADA case types. Significantly lower prevalence and average numbers of extractions were observed in mild periodontitis cases (p<0.05).

The prevalence of advanced periodontal destruction, endodontic problems, caries and technical reconstructive problems is displayed in Table 3. Data indicate that problems other than periodontal disease were present at a minority of teeth. Fig. 2 displays the reported pathologies associated with initial tooth extractions. Periodontal disease alone was reported to be the sole pathology associated with 63% of extractions, while the combination of periodontal disease with caries, endodontic or technical problems in the same tooth accounted for another 14% of extractions. Unrestorable caries, presence of untreatable endodontic pathology and/or technical problems accounted for only 23% of initial extractions in this periodontal population seeking comprehensive care.

The pathologies associated with tooth extractions during active therapy in different ADA case type definitions are displayed in Fig. 3 (top panel). Caries, endodontic and technical problems represented the leading pathology associated with individual tooth loss in gingivitis and mild periodontitis cases. Conversely, severe periodontal disease alone or in combination with other problems was present in 76 to 94% of initial extractions in moderate and severe periodontitis cases, respectively. The differences in prevalence of pathologies associated with extraction were significant (p<0.001).

The % of bone loss observed at teeth extracted for all causes during initial therapy in mild, moderate and severe periodontitis cases was also evaluated (Fig. 4). Some bone loss was observed in teeth extracted in mild periodontitis cases; bone loss averaging about 50% of root length was present in teeth extracted in moderate or severe periodontitis cases (46±24% in moderate periodontitis and 52±22% in severe periodontitis patients).

Tooth extraction during supportive periodontal care

During recall, a population average of 1±1.7 teeth/patient (median=0 teeth/patient, IQ range 0–1) were removed. The incidence of tooth loss during recall was 0.17±0.31 teeth/year of participation in the supportive periodontal care program. The 263 teeth extracted during maintenance represented 4.2% of the total number of teeth present after completion of active therapy. During recall, 41% of subjects experienced the loss of one or more teeth; in these cases the average number of teeth that was extracted amounted to 2.35±1.9 teeth/patient (median=2, IQ range 1–3). In this sub-population the incidence of tooth loss was 0.4±0.37 teeth/year.

The prevalence of problems in teeth
extracted during participation in supportive periodontal care program is displayed in Table 3. Periodontal problems remained highly prevalent (64% of extracted teeth presented with advanced periodontal destruction); interestingly, however, the prevalence of technical problems in teeth extracted during recall reached 27% (as compared with the 14% prevalence observed during active therapy). The increase in the prevalence of technical problems in teeth extracted during recall was statistically significant \((p<0.01)\). The pathologies associated with tooth extractions during recall are described in Fig. 2B. Periodontal problems alone were present in 50% of the extractions, while a combination of periodontal problems with caries, endodontic and/or technical problems accounted for another 14% of extractions. Interestingly, 36% of teeth were extracted for reasons other than periodontal disease (caries, endodontic pathology and/or technical problems).

Table 4 displays the average number of teeth that were removed during participation in the supportive periodontal care program in subgroups defined by different ADA case types at initial examination. Data indicated that teeth were extracted during recall in 45% of patients presenting with moderate periodontitis at baseline; the corresponding figure for severe periodontitis cases was 48%. This prevalence was significantly higher than the ones observed in gingivitis and mild periodontitis patients.

The pathologies associated with tooth extractions during supportive periodontal care in different ADA case type definitions are displayed in Fig. 3 (bottom panel). Caries, endodontic and technical problems represented the leading diseases linked with individual tooth loss in gingivitis and mild periodontitis cases. On the other hand, periodontal disease alone or in combination with other problems was observed in 86% of the extractions performed in severe periodontitis cases. In moderate periodontitis cases, 42% of teeth were extracted for periodontal reasons only, 18% for periodontal reasons combined with caries, endodontic or technical problems, while 40% of teeth were extracted for non-periodontal reasons. The differences in pathologies associated with individual tooth extraction observed among patients with different ADA case type definitions were significant \((p<0.001)\).

Of interest was also the comparison between the pathologies associated with tooth extraction during active treatment and those during supportive care. In general, caries, endodontic pathologies and/or technical problems were more frequently observed at teeth extracted during recall than during initial therapy. Periodontal disease was the most frequent observed pathology during both active therapy and recall in the severe periodontitis group (ADA type 4). In moderate periodontitis cases (ADA type 3), periodontal disease was the leading pathology associated with extraction during active therapy; during recall, on the other hand periodontal disease and non-periodontal causes of tooth loss displayed similar frequencies. In gingivitis and mild periodontitis cases (ADA type 1 and 2) caries, endodontic pathology and technical prob-

<table>
<thead>
<tr>
<th>ADA case type</th>
<th>(N)</th>
<th>Overall population (median, IQ range)</th>
<th>Incidence (teeth/year)</th>
<th>Prevalence (% patients)</th>
<th>Extractions patients* (median, IQ range)</th>
<th>Incidence extraction* (patients/teeth/year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>gingivitis</td>
<td>17</td>
<td>0.5±1.5 (0, 0–0)</td>
<td>0.13±0.44</td>
<td>18%</td>
<td>2.7±2.9 (1, 1–3.5)</td>
<td>0.76±0.9</td>
</tr>
<tr>
<td>mild periodontitis</td>
<td>56</td>
<td>0.5±0.9 (0, 0–1)</td>
<td>0.06±0.12</td>
<td>27%</td>
<td>1.9±0.8 (2, 1–2.5)</td>
<td>0.23±0.12</td>
</tr>
<tr>
<td>moderate periodontitis</td>
<td>131</td>
<td>1.1±1.8 (0, 0–1)</td>
<td>0.16±0.25</td>
<td>45%</td>
<td>2.3±2 (2, 1–3)</td>
<td>0.36±0.26</td>
</tr>
<tr>
<td>severe periodontitis</td>
<td>69</td>
<td>1.2±1.9 (0, 0–2)</td>
<td>0.27±0.47</td>
<td>48%</td>
<td>2.6±2 (2, 1–3)</td>
<td>0.57±0.55</td>
</tr>
</tbody>
</table>

* Average number of extractions or incidence of extractions in subjects who lost at least one tooth during recall.
Discussion

In recent years, increasing emphasis has been placed on the use of “true” rather than “surrogate” outcomes for the evaluation of the effectiveness of periodontal therapy (Hijujoel & DeRuen 1995). In this respect, long term studies evaluating tooth survival after completion of periodontal therapy have received renewed attention (McLeod et al. 1997), and have supported the concept that the combination of periodontal therapy and maintenance care is highly effective in maintaining the majority of teeth in the majority of patients. The use of tooth loss as a measure of the long-term effectiveness of periodontal therapy, however, should include an account of teeth that have been extracted during the active phase of treatment. In fact, aggressive extraction of compromised teeth during active periodontal therapy may lead to a decrease in the incidence of tooth loss during participation into a SPC program; conversely maintenance of severely compromised teeth may increase the risk of tooth loss during SPC. This investigation reports both tooth extractions during active periodontal therapy and tooth loss during SPC in a population of 273 periodontal subjects. Changes in pocket prevalence and tooth loss during maintenance care on this population have been previously reported (Tonetti et al. 1998). A total of 8.8% of the teeth present at initial examination were no longer present at the latest SPC examination; 311 were extracted during active therapy, while 263 were lost during participation in the SPC program. These data indicate that the combination of active periodontal and restorative therapy with participation in a SPC program allowed the preservation of the majority of teeth in the majority of patients.

In this population, the mean observed incidence of tooth loss during the SPC period was 0.17 teeth per patient per year. This is compatible with the prevalence of tooth loss associated with untreated periodontal disease alone, while a further 14% of lost teeth had a combination of periodontal disease with caries, endodontic and/or technical problems. The same was true when data were broken down into extractions during active therapy and extractions during SPC. Of interest was the observation that the prevalence of tooth loss associated with unrestorable caries, endodontic and technical problems was significantly higher during SPC than during active therapy (36% compared to 23%, respectively). Given the degree of reconstructive therapy delivered to this patient population, this seems to be compatible with the prevalence of technical failures and endodontic problems detected in previous studies dealing with the longevity of prosthetic abutments in periodontal subjects (Bergenholtz & Nyman 1984, Landolt & Lang 1988, Reichen-Graden & Lang 1989).

As expected, periodontal case classification at initial examination also had an impact on the percentage of teeth extracted for periodontal reasons. In severe periodontitis patients (ADA case type 4), more than 70% of extractions were associated with periodontal reasons alone and less than 10% with caries, endodontic and/or technical problems (Fig. 3). Conversely, in gingivitis and mild periodontitis subjects the majority of teeth were extracted in the absence of severe periodontal destruction. The data clearly showed that non-periodontal pathologies accounted for a minority of extractions in this periodontal population seeking comprehensive dental care. This is important since it emphasises the challenge that proper control of periodontitis and resolution of its anatomical sequelae brings to the comprehensive treatment of these cases.
The decision to extract a tooth is a complex one that is dependent upon many interrelated, interdisciplinary considerations. In particular, within the scope of a comprehensive treatment plan, a periodontally compromised tooth may be extracted even though it may be technically feasible to treat or to maintain it for a longer period. These considerations include: (i) the amount of residual periodontal support and the ability to stabilise the residual attachment at the individual tooth; (ii) the extent and the severity of periodontal destruction within the dentition; (iii) the strategic value of a compromised tooth in relation to the overall treatment plan and to the residual masticatory function; (iv) the presence of concomitant carious, endodontic and restorative problems; (v) aesthetics; (vi) the predictability, the function and the cost-benefit ratio of the available treatment alternatives. In fact, spontaneous tooth exfoliation, the true result of the final stages of periodontitis, was not observed in this population. In fact only 14.6% of teeth extracted with periodontal disease as the only associated pathology had a radiographic bone loss greater than 80%. The decision to extract a tooth for periodontal reasons, therefore, was based on the considerations above. In this respect it should be noted that this report is comprised of the outcome of treatment that has been rendered by a variety of clinicians. These were practising according to set standards and to a single philosophy of treatment. Inter-individual variations among the clinicians in the decision to extract a tooth during the initial phase of treatment or during SPC, however, are to be expected.

Data that related to the cause of tooth extraction during both initial and supportive periodontal therapy should be carefully interpreted in terms of its applicability to different populations or clinical settings. The study population, in fact, could have been biased by referral of particularly motivated patients to a specialised academic institution and further skewed by the fact that was selected based on participation in a secondary prevention program. Considerable sub-populations experienced extractions: 46% of patients received tooth extractions as part of their active treatment and 41% during their participation in the secondary prevention program. In the subgroup whose treatment plan included extractions the average number was 2.5±1.6 teeth per patient. Likewise, the patients who received extractions during recall lost an average of 2.35±1.9 teeth per subject with an incidence of 0.4±0.37 teeth per patient per year. These data reinforce the concept that a minority of the population is responsible for the majority of tooth extractions, both during active therapy and SPC (Hirschfeld & Wasserman 1978, Tonetti et al. 1998).

The following conclusions can be drawn from this retrospective survey of tooth loss. 8.8% of teeth present at the initial examination were extracted either during active therapy or the subsequent SPC period. This compares with 4.2% of teeth at risk being lost during SPC and suggests that initial extractions should be taken into account to compare the overall impact of comprehensive therapy on tooth loss. Non-periodontal causes of tooth loss, i.e. unrestorable caries, untreatably endodontic pathology and/or technical problems, were present at a minority of extracted teeth. Advanced periodontitis was associated with the majority of teeth that were extracted and was the only obvious pathology in 57% of all cases of extraction. In a further 14% of cases advanced periodontitis was combined with caries, endodontic pathology and/or technical reconstructive problems. Tooth extractions were experienced by specific sub-populations and a minority of cases accounted for the majority of extractions.

Acknowledgements
This study was supported by the Swiss National Science Foundation Grant #32–37763.93 and the Clinical Research Foundation for the Promotion of Oral Health of the University of Bern.

Zusammenfassung
Initiale Extraktionen und Zahnerhalt während der Erhaltungstherapie in einer Popula
tion mit umfassender periodontaler Betreuung
Diese retrospektive Studie hatte zum Ziel, dass bei einer Parodontitispatientenpopula
tion, welche eine umfassende Betreuung bekam, die Prävalenz von Zahnerhalten sowie die pathologischen Zustände, die dazu führten, bestimmt werden sollten. Insgesamt wurden 273 randomisiert aus gewählte Personen der Oralprophylaxeklinik der Universität Bern in die Studie eingeschlossen. Alle Personen bekamen eine umfassende parodontale und restorative Betreuung und nahmen an einem überwachten Erhaltungstherapieprogramm mit einer Dauer von durchschnittlichen Betreuungsdauer von 67±46 Monaten teil (zwischen 5 bis 278 Monate). Die Population bestand aus 39.6% aktuellen Rauchern und 27.8% früheren Rauchern. 6.2% der Patienten hatten eine Gingivitis, 20.5% eine leichte Parodontitis, 48.4% eine moderate und 24.9% eine schwere Parodontitis. Die durchschnittliche Häufigkeit der Recalltermine betrug 4.4±1.5 Besuche pro Jahr (zwischen 1.7–12 Besuche/Jahr). Die Ergebnisse zeigten, dass 574 von insgesamt 6503 Zähnen extrahiert wurden; 311 Zähne wurden während der aktiven Therapie extrahiert und 263 während der Phase der Erhaltungstherapie (SPC). 46% der Patienten hatten Zahnerhaltungen während der aktiven Behandlung und 41% während der Teilnahme am Präventionsprogramm. In der Patientenuntergruppe der Behandlungsplan Extraktionen beinhalte
tete war die durchschnittliche Zahl der Ex
taktionen 2.5±1.6 Zähne pro Patient. Die Patienten, die Extraktionen während des Re
calls hatte verloren im Durchschnitt 2.35±1.9 Zähne pro Patient mit einer Inzi
denz von 0.4±0.37 Zähnen pro Patient und Jahr. Diese Daten bestärken das Konzept, dass eine Minderheit der Population für die Mehrheit der Zahnerhaltungen, sowohl während der aktiven Behandlung als auch während der SPC verantwortlich ist. Parodontalerkran
kung war die einzige Pathologie, die bei 57% der extrahierten Zähne beobach
tet wurde; während Karies, endodontische und technische Probleme ohne Vorhanden
zein von Parodontitis bei 29% der Fälle beob
achtet wurden. Diese Beobachtungen zeigen, dass die geleistete Behandlung bei diesen Pa
tienten effektiv in der langfristigen Erhaltung des Gebisses war und sie lassen annehmen, dass in dieser Population eine fortgeschritte
e Parodontalerkrankung den Hauptgrund für Zahnerhalt darstellt.

Résumé
Extractions initiales et pertes dentaires pendant la phase de soutien dans une population atteinte de parodontite et nécessitant des traitements globaux
L’objectif de cette étude rétrospective a été de déterminer la prévalence des extractions dentaires et des pathologies qui leur sont associées pendant les phases de traitement actif et la phase de maintenance de traitements parodontaux, dans une population de patients atteints de maladies parodontales et nécessitant des traitements globaux. Un total de 273 sujets sélectionnés au hasard dans le service de prophylaxie de l’université de Berne furent inclus dans l’étude. Tous avaient reçu des soins globaux comprenant des traitements de parodontie et de dentisterie restauratrice et suivaient un programme de maintenance di
dirigé depuis 67±46 mois en moyenne (de 5 à 278 mois). Cette population était composée de 39.6% de fumeurs, et de 27.8% d’anciens fumeurs. 6.2% de ces patients présentaient une gingivite, 20.5% une parodontite légère,
48.8% une parodontite modérée et 24.9% une parodontite sévère. La fréquence moyenne des visites de rappel était 4.4±1.5 rendez-vous par an (de 1.7 à 12 rendez-vous par an). Les résultats indiquent que 574 dents, sur un total de 6503, ont été extraites; 311 dents fu rent extraites pendant le traitement actif, et 263 pendant la phase de traitement parodon tal de soutien. 46% des patients ont eu des dents extraites pendant la phase active de traitement et 41% pendant leur participation au programme de prévention secondaire. Dans le sous-groupe de patients pour lesquels les extractions faisaient partie du plan de traitement, le nombre moyen d’extraction était de 2.5±1.6 dents par patients. De la même façon, 2.35±1.9 dents furent perdues par les patients qui subirent des extractions lors de la phase de maintenance avec une inci dence de 0.4±0.37 dents par patients et par an. Ces données renforce le concept selon lequel une minorité de la population est responsable de la majorité des extractions dentaires, à la fois pendant la phase active et pendant la phase de maintenance. La maladie parodontale était la seule pathologie responsable de 57% des extractions alors que les caries, les pathologies endodontiques et les problèmes techniques hors parodontite étaient rencontrés dans 29% des cas. Ces obser vations indiquent que le traitement rendu était efficace pour la maintenance à long terme de la denture de ces sujets et sug gèrent que la maladie parodontale avancée repré sente la cause majeure de perte dentaire dans cette population.

References


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