A Proposed Index for Residual Periodontal Ligament Support

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An index was developed to estimate the residual periodontal ligament support for individual teeth during treatment planning for partially edentulous patients. The Residual Periodontal Ligament Index (rPLI) was derived from a formula that calculates the remaining area of periodontal attachment and the Normal Periodontal Ligament Index (nPLI). To illustrate the applicability of the rPLI, the total nPLI scores of the remaining teeth corresponding to Eichner subclasses of partial edentulism were charted by assessing the average occlusal support numerically. The rPLI is proposed to be a possible suitable tool for epidemiologic research on the progression of tooth loss and the survival rate of prostheses. *Int J Prosthodont 2010;23:472–474.*

The clinical assessment of any residual dentition's periodontal support is an integral part of prosthodontic treatment planning. The ongoing status of support is evaluated clinically by measuring pocket depth, attachment level, and tooth mobility, as well as by intraoral radiographs.[1] In this study, an index for estimating residual periodontal ligament support and the corresponding occlusal support according to tooth type is proposed.

Materials and Methods

Previously, Yamamoto et al[2] provided data on the periodontal ligament area for each tooth in both arches (Table 1). The Normal Periodontal Ligament Index (nPLI) for each individual tooth was calculated as the ratio of the tooth's normal periodontal ligament area to the entire normal periodontal ligament area of the arch (calculated for 14 unilateral maxillary and mandibular teeth). The total nPLI of the 14 unilateral teeth was determined to be 50, with a bilateral score of 100. Therefore, the working formula was:

$$nPLI = [(\text{individual tooth's normal periodontal ligament area} / 3{,}869.7) \times 100] / 2$$

According to Yamamoto et al,[2] the residual periodontal ligament area percentage for each tooth (Y) can be calculated as:

$$Y = a + bX$$

where a and b are coefficients of each tooth type (Table 1) and X is the attachment level (mm), defined as the distance from the cementoenamel junction to the tip of the inserted probe.[1] This formula was applied to derive a new index, the Residual Periodontal Ligament Index (rPLI), as follows:

$$rPLI = nPLI \times (Y / 100) = nPLI \times [(a + bX) / 100]$$

In this equation, nPLI is considered the initial index of the rPLI.

To illustrate the applicability of the rPLI, the maximum and minimum total nPLI scores of the remaining teeth corresponding to the Eichner classification for assessing the average occlusal support numerically were charted. Eichner classification is a system based on existing natural tooth contacts between the maxilla and

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Table 1 Root Length, Root Surface Area, and nPLI and rPLI of Each Tooth

	Root length (mm)	Root surface area (mm^2)	nPLI	rPLI
Maxilla				
Central incisor	12.2	200.7	2.6	2.6 × (97.4–8.52X) / 100
Lateral incisor	13.4	202.9	2.6	2.6 × (97.7–8.73X) / 100
Canine	16.6	291.9	3.8	3.8 × (99.4–7.09X) / 100
First premolar	12.9	249.4	3.2	3.2 × (98.2–8.53X) / 100
Second premolar	13.9	232.9	3.0	3.0 × (96.6–8.67X) / 100
First molar	13.5	467.7	6.0	6.0 × (102.4–8.28X) / 100
Second molar	12.7	368.4	4.8	4.8 × (99.8–8.49X) / 100
Mandible				
Central incisor	12.0	159.5	2.1	2.1 × (98.2–8.00X) / 100
Lateral incisor	12.6	180.0	2.3	2.3 × (98.9–8.90X) / 100
Canine	14.9	265.2	3.4	3.4 × (98.7–7.67X) / 100
First premolar	14.7	237.5	3.1	3.1 × (97.2–8.16X) / 100
Second premolar	14.0	212.4	2.7	2.7 × (96.5–8.56X) / 100
First molar	12.6	432.8	5.6	5.6 × (100.7–7.99X) / 100
Second molar	12.6	368.4	4.8	4.8 × (98.9–8.42X) / 100

Data were obtained from Yamamoto et al.[2]
nPLI = Normal Periodontal Ligament Index; rPLI = Residual Periodontal Ligament Index.

Table 2 Eichner Classification of Occlusal Support

Classification	M2	M1	PM2	PM1	C	LI	CI	CI	LI	C	PM1	PM2	M1	M2
A1														
Maxilla	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Mandible	O	O	O	O	O	O	O	O	O	O	O	O	O	O
A2														
Maxilla	O	O	O	O	O	O	O	O	O	O	O	O	O	O
Mandible	O	X	O	O	O	O	O	O	O	O	O	O	X	O
A3														
Maxilla	O	X	O	O	O	O	O	O	O	O	O	O	X	O
Mandible	O	X	O	O	O	O	O	O	O	O	O	O	X	O
B1														
Maxilla	O	X	O	O	O	O	O	O	O	O	O	O	X	O
Mandible	X	X	O	O	O	O	O	O	O	O	O	O	X	O
B2														
Maxilla	O	X	O	O	O	O	O	O	O	O	O	O	X	O
Mandible	X	X	O	O	O	O	O	O	O	O	O	O	X	X
B3														
Maxilla	X	X	X	X	O	O	O	O	O	O	O	X	X	X
Mandible	X	X	X	O	O	O	O	O	O	O	O	X	X	X
B4														
Maxilla	X	X	X	X	O	O	O	O	O	O	X	X	X	X
Mandible	X	X	X	X	O	O	O	O	O	O	X	X	X	X
C1														
Maxilla	X	X	X	X	O	X	X	X	X	O	X	X	X	X
Mandible	X	X	X	X	X	O	O	O	O	X	X	X	X	X
C2														
Maxilla	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mandible	X	X	X	X	O	O	O	O	O	O	X	X	X	X
C3														
Maxilla	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Mandible	X	X	X	X	X	X	X	X	X	X	X	X	X	X

M2 = second molar; M1 = first molar; PM2 = second premolar; PM1 = first premolar; C = canine; LI = lateral incisor; CI = central incisor;
O = tooth present; X = tooth lost.

mandible in the bilateral premolar and molar regions (Table 2).[3] Class A represents contact in all four occlusal support zones and is divided into three subclasses: no tooth loss in both arches (A1), tooth loss in one arch (A2), and tooth loss in both arches (A3). Class B represents contact in three (B1), two (B2), or one (B3) support zones or contact of the anterior teeth only (B4). Class C represents an absence of tooth contact and is divided into subclasses C1 (no contact of the remaining teeth in both arches), C2 (edentulous in one arch), and C3 (edentulous in both arches).

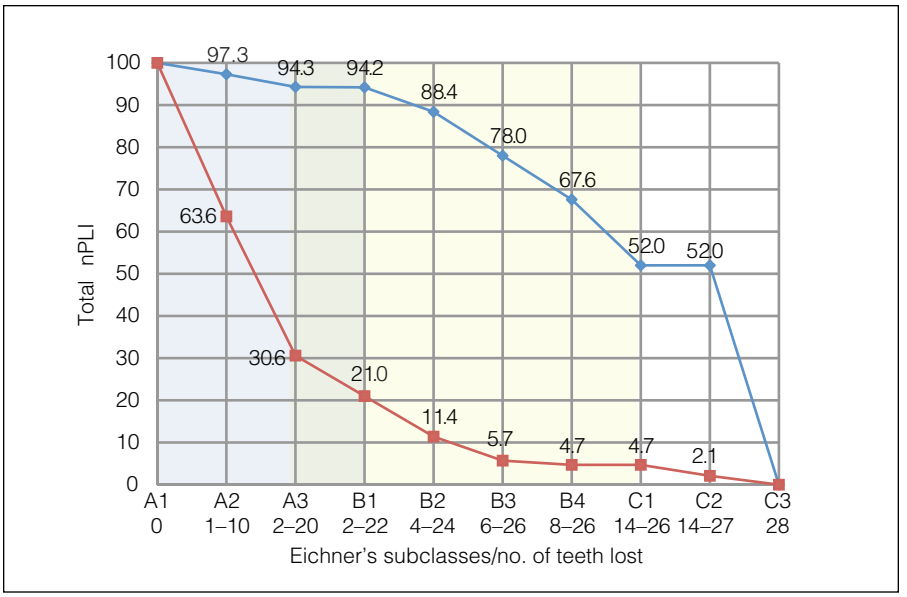

Fig 1 Maximum *(blue)* and minimum *(red)* total nPLI scores of the remaining teeth corresponding to Eichner classification.

Results

The rPLI of each tooth type is shown in Table 1, and the maximum and minimum total nPLI scores of the remaining teeth corresponding to Eichner classification are shown in Fig 1. The total nPLI scores in classes A, B, and C were in the range of 30.6 to 100, 4.7 to 94.2, and 0.0 to 52.0, respectively. When the remaining teeth lost periodontal support, the total rPLI score was lower than the total nPLI score.

Discussion

When designing fixed and removable partial dentures, the occlusal support of the remaining teeth is usually assessed on the assumption that these teeth have normal optimal periodontal ligament support.[4] However, the residual periodontal ligament area has not been assessed for determining occlusal support. Therefore, the rPLI was developed and applied to determine the average occlusal support in terms of Eichner classification. For example, the total nPLI score of a shortened dental arch comprising anterior and premolar teeth (ie, class B2) to fulfill the requirements of a functional dentition is 57.7. Since first molar contacts are presumed to play an important role in oral health–related quality of life,[5] the total nPLI score of a dental arch comprising anterior, premolar, and first molar teeth (ie, class A3) would be 81.0, approximately 40% higher than that of class B2. Therefore, the rPLI could be a suitable tool in epidemiologic research on the progression of tooth loss and the survival rate of prostheses. Moreover, it could also be used in the selection of abutment teeth for fixed partial dentures in the context of Ante's law.[4] In future studies, the suitability of the rPLI for prosthodontic treatment planning, such as in selecting abutment teeth, establishing criteria for tooth extraction, choosing implants, and determining the optimal extent of denture base areas, will be verified.

Conclusion

The rPLI was developed to estimate the residual periodontal ligament support in partially edentulous patients as an adjunct during prosthodontic treatment planning. The index assesses average residual occlusal support in the context of Eichner classification.

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References

1. Papapanou PN, Lindhe Y. Epidemiology of periodontal disease. In: Lindhe Y, Karring T, Lang NP (eds). Clinical Periodontology and Implant Dentistry, ed 3. Copenhagen: Munksgaard, 1997:69–101.
2. Yamamoto T, Kinoshita Y, Tsuneishi M, Takizawa H, Umemura O, Watanabe T. Estimation of the remaining periodontal ligament from attachment-level measurements. J Clin Periodontol 2006;33:221–225.
3. Eichner K. Über eine gruppeneinteilung des lückengebisses für die prothetik. Dtsche Zahnärztl Z 1955;10:1831–1834.
4. Lulic M, Brägger U, Lang NP, Zwahlen M, Salvi GE. Ante's (1926) law revisited: A systematic review on survival rates and complications of fixed dental prostheses (FDPs) on severely reduced periodontal tissue support. Clin Oral Implants Res 2007;18(suppl 3):63–72 [erratum 2008;19:326–328].
5. Baba K, Igarashi Y, Nishiyama A, et al. Patterns of missing occlusal units and oral health–related quality of life in SDA patients. J Oral Rehabil 2008;35:621–628.