Package: tooth (via r-universe)

October 21, 2026

Title Dental Public Health Indices and Odontogram Visualizations

Version 0.5.0

Description Computes dental caries indices (DMFT, DMFS, dmft, dmfs) from surface-level clinical examination data and produces odontogram heatmap visualizations of per-tooth-surface outcomes. Supports primary and permanent dentition with configurable teeth per quadrant (5 to 8), separate root and coronal caries tallying, long and wide input formats, stratified output, and FDI/Universal/quadrant tooth numbering conversion.

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URL https://github.com/ddmsel/tooth

BugReports https://github.com/ddmsel/tooth/issues

Encoding UTF-8

Language en-US

LazyData true

Roxygen list(markdown = TRUE)

RoxygenNote 7.3.2

Depends R (>= 4.1.0)

Imports dplyr (>= 1.0.0), ggplot2 (>= 3.4.0), patchwork, purrr, rlang, tibble

Suggests knitr, rmarkdown, testthat (>= 3.0.0)

Config/testthat/edition 3

VignetteBuilder knitr

NeedsCompilation no

Author David Selvaraj [aut, cre, cph] (<https://orcid.org/0000-0003-4055-9493>), Suchitra Nelson [aut]

Maintainer David Selvaraj <dms256@case.edu>

Repository https://ddmsel.r-universe.dev

Date/Publication 2026-07-13 21:15:39 UTC

RemoteUrl https://github.com/ddmsel/tooth

RemoteRef HEAD

RemoteSha cfcbdbb8a9e925005dba5bad3821eadeff1dfeda

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`build_odontogram` *Build a surface-level odontogram heatmap*

Description

Draws a full-arch odontogram with colour-coded tooth surfaces. Supports primary and permanent dentition (5–8 teeth per quadrant), selective surfaces, stratification, summary statistics with significance testing, and configurable tooth numbering.

Usage

```
build_odontogram(
  data,
  value_col = "prop",
  dentition = "permanent",
  teeth_per_quadrant = NULL,
  title = "Surface Odontogram",
  subtitle = NULL,
  color_low = "#FFFFFF",
  color_high = "#C62828",
  na_color = "grey90",
  min_val = NULL,
  max_val = NULL,
  legend_title = "Proportion",
  show_roots = TRUE,
  surfaces = c("buc", "lin", "mes", "dis", "occ", "rootb", "rootl", "rootm", "rootd"),
  show_labels = TRUE,
```

```
  label_size = 1.8,
  tooth_label_size = 3,
  numbering = c("quadrant", "fdi", "universal"),
  strata = NULL,
  strata_labels = NULL,
  stats = NULL,
  stats_test = NULL,
  stats_var = NULL,
  stats_raw = NULL,
  footnote = NULL,
  combine = TRUE,
  ncol = 1
)
```

Arguments

data	Data frame with at least tooth_num (e.g. "ur1"), tooth_surface (e.g. "buc", "occ", "rootb"), and a numeric value column. If stratifying, include the column named in strata.
value_col	Name of the numeric column to map to fill colour.
dentition	"permanent" or "primary".
teeth_per_quadrant	Integer 5–8 (default derived from dentition).
title, subtitle	Plot title/subtitle.
color_low, color_high	Gradient endpoints (default "#FFFFFF" to "#C62828").
na_color	Fill for missing surfaces (default "grey90").
min_val, max_val	Lower and upper limits for the colour scale. Both auto-detected when NULL. Set manually to fix the range across multiple plots.
legend_title	Legend title.
show_roots	Logical; draw root caries bars.
surfaces	Character vector of surfaces to draw.
show_labels	Logical; show surface abbreviation labels (B, L, M, D, O, RB, RL, RM, RD) inside each surface polygon.
label_size	Numeric; size of surface labels.
tooth_label_size	Numeric; size of tooth number labels (default 3).
numbering	Tooth numbering system for display: "quadrant" (default), "fdi", or "universal".
strata	Optional column name for stratification.
strata_labels	Optional named character vector to relabel strata in panel titles.
stats	Optional data frame of per-group summary statistics to display below each panel. Must contain a column matching strata and numeric columns to display (e.g. n, mean_DMFT, mean_DT). See Details.

stats_test	Method for comparing stats across strata: "t" for t-test (default), "wilcox" for Wilcoxon rank-sum, or NULL to skip. P-values are shown as significance stars.
stats_var	Column name in stats_raw to test for differences (e.g. "DMFT"). Required when stats_test is not NULL.
stats_raw	Optional data frame of individual-level data used for significance testing. Must contain a column matching strata and a numeric column matching stats_var. Required when stats_test is set.
footnote	Optional character string displayed below the plot as a caption. Use for abbreviation explanations and p-value definitions.
combine	Logical; if strata is set, combine panels into one plot (default TRUE) or return a named list.
ncol	Number of columns when combining stratified panels.

Details

Summary statistics: Pass a data frame to stats with one row per stratum. Example:

```
stats_df <- data.frame(
  treatment = c("SDF", "ART"),
  n = c(120, 115),
  mean_DT = c(2.3, 2.8),
  mean_DMFT = c(5.1, 5.6)
)
build_odontogram(d, strata = "treatment", stats = stats_df)
```

Significance stars: When stats_test and stats_var are set and raw data is provided via stats_raw, p-values are computed and appended: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, ns otherwise.

Value

A ggplot object (or list of ggplots if combine = FALSE).

Examples

```
library(tibble)
d <- expand.grid(
  tooth_num = paste0(rep(c("ur","ul","lr","ll"), each=7), 1:7),
  tooth_surface = c("buc","lin","mes","dis","occ"),
  stringsAsFactors = FALSE
)
d$prop <- runif(nrow(d))
build_odontogram(d, teeth_per_quadrant = 7)
```

`calc_dmfs` *Calculate DMFS / dmfs index from surface-level data*

Description

Computes Decayed, Missing, and Filled Surfaces per person. Can separate root from coronal surfaces. Accepts long or wide format.

Usage

```
calc_dmfs(
  data,
  format = c("long", "wide"),
  id = "record_id",
  group = NULL,
  strata = NULL,
  lesion_col = "lesion_code",
  activity_col = "act",
  filling_col = "filling_code",
  tooth_code_col = "code",
  root_lesion_col = NULL,
  root_surfaces = c("rootb", "rootl", "rootm", "rootd"),
  decayed_codes = c(3, 4, 5, 6),
  activity_codes = c(2),
  filled_codes = c(1, 2, 4, 5, 6, 7, 8),
  missing_codes = c(1),
  root_decayed_codes = NULL,
  consider_activity = TRUE,
  consider_activity_coronal = NULL,
  consider_activity_root = NULL
)
```

Arguments

`data`	Data frame. In **long format**: one row per tooth-surface with columns for id, tooth_num, tooth_surface, and clinical codes. In **wide format**: one row per person-tooth with surface codes in separate columns.
`format`	`"long"` (default) or `"wide"`. See Details.
`id`	Person-identifier column (default `"record_id"`).
`group`	Optional grouping column(s) for repeated measures, e.g. `"redcap_event_name"`. Character vector.
`strata`	Optional stratification column(s), e.g. `"treatment"`. The output will include these columns for downstream group summaries.
`lesion_col`, `activity_col`, `filling_col`, `tooth_code_col`	Column names for ICDAS codes (long format).

`root_lesion_col`
: Optional column for root surface lesion codes. When provided, root caries (RDT) is calculated separately from coronal (DT). Set to NULL to ignore root caries (default).

`root_surfaces`
: Character vector of surface names considered root surfaces. Default `c("rootb","rootl","rootm","roo`

`decayed_codes`
: Numeric vector of lesion codes considered **decayed** (default `c(3,4,5,6)` for ICDAS).

`activity_codes`
: Numeric vector of activity codes indicating **active** caries (default `c(2)`).

`filled_codes`
: Numeric vector of filling codes indicating a **restoration** is present (default `c(1,2,4,5,6,7,8)`).

`missing_codes`
: Numeric vector of tooth-level codes indicating the tooth is **missing** (default `c(1)`).

`root_decayed_codes`
: Numeric vector for root caries codes (default same as `decayed_codes`).

`consider_activity`
: Logical; overall default for whether a lesion must also carry an active-caries code (`activity_codes`) to be counted as decayed. `TRUE` (default) requires activity; `FALSE` counts any lesion in `decayed_codes` regardless of activity. Standard epidemiological D(3)MFT counts all cavitated lesions irrespective of activity, so set `FALSE` to match that convention. When `FALSE`, the activity column is not referenced and need not be present.

`consider_activity_coronal`, `consider_activity_root`
: Optional logical overrides for the coronal and root components. `NULL` (default) inherits `consider_activity`. Use these to treat crown and root caries differently (e.g. require activity coronally but not for roots, where activity is often not assessed): `consider_activity_root = FALSE`.

Value

A tibble with one row per person (and group/strata) containing: `DS`, `FS`, `MS`, `DFS`, `DMFS`, plus optional `RDS` (root decayed surfaces) when `root_lesion_col` is set, and binary indicators.

`calc_dmft` *Calculate DMFT / dmft index from surface- or tooth-level data*

Description

Computes Decayed, Missing, and Filled Teeth counts per person. Handles both primary and permanent dentition. Can separate root caries from coronal caries. Accepts long or wide format data.

Usage

```
calc_dmft(
  data,
  format = c("long", "wide"),
  id = "record_id",
```

```
  group = NULL,
  strata = NULL,
  lesion_col = "lesion_code",
  activity_col = "act",
  filling_col = "filling_code",
  tooth_code_col = "code",
  root_lesion_col = NULL,
  root_surfaces = c("rootb", "rootl", "rootm", "rootd"),
  decayed_codes = c(3, 4, 5, 6),
  activity_codes = c(2),
  filled_codes = c(1, 2, 4, 5, 6, 7, 8),
  present_codes = c(2, 3, 4, 5, 6, 7, 8),
  missing_codes = c(1),
  root_decayed_codes = NULL,
  consider_activity = TRUE,
  consider_activity_coronal = NULL,
  consider_activity_root = NULL
)
```

Arguments

`data`	Data frame. In **long format**: one row per tooth-surface with columns for id, tooth_num, tooth_surface, and clinical codes. In **wide format**: one row per person-tooth with surface codes in separate columns.
`format`	`"long"` (default) or `"wide"`. See Details.
`id`	Person-identifier column (default `"record_id"`).
`group`	Optional grouping column(s) for repeated measures, e.g. `"redcap_event_name"`. Character vector.
`strata`	Optional stratification column(s), e.g. `"treatment"`. The output will include these columns for downstream group summaries.
`lesion_col`, `activity_col`, `filling_col`, `tooth_code_col`	Column names for ICDAS codes (long format).
`root_lesion_col`	Optional column for root surface lesion codes. When provided, root caries (RDT) is calculated separately from coronal (DT). Set to NULL to ignore root caries (default).
`root_surfaces`	Character vector of surface names considered root surfaces. Default `c("rootb","rootl","rootm","roo`
`decayed_codes`, `activity_codes`, `filled_codes`, `present_codes`, `missing_codes`	Numeric vectors defining clinical code categories. Defaults match ICDAS. See the *Diagnostic threshold* section for `decayed_codes`.
`root_decayed_codes`	Numeric vector for root caries codes (default same as `decayed_codes`).
`consider_activity`	Logical; overall default for whether a lesion must also carry an active-caries code (`activity_codes`) to be counted as decayed. `TRUE` (default) requires activity; `FALSE` counts any lesion in `decayed_codes` regardless of activity. Standard

epidemiological D(3)MFT counts all cavitated lesions irrespective of activity, so set FALSE to match that convention. When FALSE, the activity column is not referenced and need not be present.

consider_activity_coronal, consider_activity_root
: Optional logical overrides for the coronal and root components. NULL (default) inherits consider_activity. Use these to treat crown and root caries differently (e.g. require activity coronally but not for roots, where activity is often not assessed): consider_activity_root = FALSE.

Value

A tibble with one row per person (and group/strata) containing:

DT Decayed teeth (coronal)

FT Filled teeth (not decayed)

MT Missing teeth

DFT Decayed or filled teeth

DMFT Decayed + missing + filled teeth

num_teeth Count of teeth present

RDT Root-decayed teeth (only when root_lesion_col is set)

DT_yn, DFT_yn Binary indicators

Diagnostic threshold

The default decayed_codes = c(3, 4, 5, 6) implements the **D3 threshold**: only ICDAS codes 3–6 (localised enamel breakdown through extensive cavitation) are scored as decayed, while ICDAS 1–2 (non-cavitated initial enamel lesions) are treated as sound. This D(3)MFT convention is the one most commonly reported in caries epidemiology. To use the more sensitive D1 threshold that also counts early enamel lesions, pass decayed_codes = c(1, 2, 3, 4, 5, 6).

Wide format

When format = "wide", each row is one person (and optional group). You must supply columns named like {tooth}_{surface}_{code_type} or use the wide_cols parameter. Alternatively, pass a pivot_spec — but the easiest approach is to reshape to long with pivot_to_long() first.

---

draw_tooth *Draw a single tooth as polygon geometry*

Description

Produces crown surface wedges (B/L/M/D/O) and up to four root surface bars (RB/RL/RM/RD), plus labels, outlines, and diagonals — all as data frames ready for ggplot2. Any surface can be excluded via the surfaces argument.

Usage

```
draw_tooth(
  tooth_id,
  quadrant,
  tooth_num,
  is_upper,
  surface_values,
  value_col = "prop",
  x_offset = 0,
  y_offset = 0,
  tooth_size = 1,
  show_roots = TRUE,
 surfaces = c("buc", "lin", "mes", "dis", "occ", "rootb", "rootl", "rootm", "rootd"),
  display_label = NULL
)
```

Arguments

`tooth_id`	Character label, e.g. `"ur1"`.
`quadrant`	One of `"ur"`, `"ul"`, `"lr"`, `"ll"`.
`tooth_num`	Numeric position within the quadrant.
`is_upper`	Logical; TRUE for upper arch.
`surface_values`	Data frame with `tooth_surface` and a value column. Recognised surfaces: buc, lin, mes, dis, occ, rootb, rootl, rootm, rootd.
`value_col`	Name of the value column in `surface_values`.
`x_offset, y_offset`	Numeric offsets for positioning.
`tooth_size`	Numeric side length of the crown square (default 1).
`show_roots`	Logical; draw root surface bars (default TRUE).
`surfaces`	Character vector of surfaces to include. Omit any you don't want drawn.
`display_label`	Optional custom label for the tooth number (e.g. FDI notation `"11"` instead of `"ur1"`). When NULL, uses `tooth_id`.

Value

Named list of tibbles: crown, roots, labels, num_label, diags, outline.

`pivot_to_long` *Pivot wide tooth data to long format*

Description

Helper to reshape wide-format data (one row per person-tooth, surfaces as separate columns) into the long format expected by `calc_dmft()`.

Usage

```
pivot_to_long(
  data,
  id = "record_id",
  group = NULL,
  strata = NULL,
  lesion_suffix = "_les",
  filling_suffix = "_fil",
  activity_suffix = "_act",
  code_suffix = "_code"
)
```

Arguments

`data`	Wide data frame.
`id`	Person ID column name.
`group`	Optional grouping columns.
`strata`	Optional stratification columns.
`lesion_suffix, filling_suffix, activity_suffix`	Suffixes that identify the surface-level columns (default `"_les"`, `"_fil"`, `"_act"`).
`code_suffix`	Suffix for tooth-level code columns (default `"_code"`).

Details

Expects columns following the naming convention: `{tooth}_{surface}_les`, `{tooth}_{surface}_fil`, `{tooth}_{surface}_act`, and `{tooth}_code` for tooth-level status.

Value

A long-format tibble.

---

sim_exam *Simulated dental examination data*

Description

A simulated surface-level dental examination dataset for 20 patients, each with 7 teeth per quadrant (28 teeth) and 5 coronal surfaces plus 2 root surfaces per tooth. Designed for demonstrating and testing `calc_dmft()`, `calc_dmfs()`, and `build_odontogram()`.

Usage

```
sim_exam
```

Format

A data frame with 3,920 rows and 7 columns:

record_id Patient identifier (character, "P01" to "P20").

tooth_num Tooth identifier in quadrant notation (e.g. "ur1", "ll7").

tooth_surface Surface name: buc, lin, mes, dis, occ, rootb, or rootl.

lesion_code ICDAS lesion code (integer 0-6). 0 = sound, 3-6 = caries.

filling_code Filling/restoration code (integer). 0 = none, 1-8 = restored.

act Lesion activity code (integer). 1 = inactive, 2 = active.

code Tooth-level status code (integer). 1 = missing, 2-8 = present.

Examples

```
data(sim_exam)
head(sim_exam)
calc_dmft(sim_exam)
```

---

summarise_dmft *Summarise DMFT results by group*

Description

Takes the output of `calc_dmft()` and produces a summary table with n, mean number of teeth, mean DT, mean DMFT, and optionally other columns — ready to pass directly to `build_odontogram()` via `stats` and `stats_raw`.

Usage

```
summarise_dmft(dmft_data, group_col, digits = 1)
```

Arguments

`dmft_data`	Data frame returned by `calc_dmft()`, optionally merged with grouping variables (e.g. treatment arm, visit frequency).
`group_col`	Column name to summarise by (e.g. `"treatment"`).
`digits`	Number of decimal places for means (default 1).

Value

A list with two elements:

stats Summary data frame with one row per group, containing `n`, `mean_teeth`, `mean_DT`, `mean_DMFT`. Column names match what `build_odontogram()` expects for `stats`.

raw The input data frame, for passing to `stats_raw` in `build_odontogram()`.

Examples

```
data(sim_exam)
dmft <- calc_dmft(sim_exam)
dmft$treatment <- ifelse(
  as.numeric(gsub("P", "", dmft$record_id)) <= 10, "SDF", "ART"
)
result <- summarise_dmft(dmft, "treatment")
result$stats
# Pass directly to build_odontogram:
# build_odontogram(d, strata = "treatment",
#   stats = result$stats, stats_raw = result$raw,
#   stats_test = "wilcox", stats_var = "DMFT")
```

---

tooth_config *Generate tooth configuration for an arch*

Description

Creates a tibble of tooth IDs for primary or permanent dentition with a configurable number of teeth per quadrant (5-8).

Usage

```
tooth_config(dentition = c("permanent", "primary"), teeth_per_quadrant = NULL)
```

Arguments

`dentition`	Character: `"permanent"` (default) or `"primary"`.
`teeth_per_quadrant`	Integer 5-8. Defaults to 8 for permanent, 5 for primary.

Value

A tibble with columns: `quadrant`, `num`, `tooth_id`, `is_upper`.

---

tooth_convert *Convert between tooth numbering systems*

Description

Converts between FDI (ISO 3950), Universal (ADA), and the internal quadrant format used by this package (`"ur1"`, `"ll5"`, etc.).

Usage

```
tooth_convert(x, from = "fdi", to = "quadrant", dentition = "permanent")
```

Arguments

x	Character or numeric vector of tooth numbers.
from	Numbering system of the input: "fdi", "universal", or "quadrant".
to	Target numbering system: "fdi", "universal", or "quadrant".
dentition	"permanent" or "primary". Required when converting from/to "universal" with primary teeth.

Details

The "universal" system follows the standard ADA conventions: permanent teeth are numbered **1–32** (1 = upper-right third molar, 32 = lower-right third molar), while primary teeth use the **letters A–T** (A = upper-right second primary molar, T = lower-right second primary molar). FDI two-digit codes are 11–48 for permanent and 51–85 for primary dentition.

Value

Character vector in the target system.

Examples

```
tooth_convert("11", from = "fdi", to = "quadrant")
tooth_convert("ur1", from = "quadrant", to = "fdi")
tooth_convert(c("1", "16", "17", "32"), from = "universal", to = "fdi")
# Primary dentition uses ADA letters A-T for the universal system:
tooth_convert("ur1", from = "quadrant", to = "universal",
              dentition = "primary")   # "E"
tooth_convert("K", from = "universal", to = "fdi", dentition = "primary")
```

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