EARLY SURVIVAL OF SINGLE-TOOTH IMPLANTS IN THE ESTHETIC ZONE MAY BE PREDICTABLE DESPITE TIMING OF IMPLANT PLACEMENT OR LOADING

SUMMARY

Selection Criteria
The authors used MEDLINE, EMBASE, and CENTRAL (Cochrane Central Register of Controlled Trials) databases to locate studies for this systematic review (SR). For studies to be eligible for this SR, all had to evaluate single-implant restorations with a follow-up of at least 1 year after implant loading. A total of 19 prospective studies met inclusion and exclusion criteria. Fifteen studies provided implant survival data (499 patient/509 implants), whereas 5 studies provided radiographic marginal bone height data (52 patients/52 implants). The analysis included studies with patients with single anterior or premolar; maxillary or mandibular edentulous sites bounded by anterior and posterior neighboring teeth. Meta-analyses of prospective trials (randomized-controlled trials, clinical trials, cohort studies, case series) reported loaded implant survival with one-year or more than one-year follow-up. Meta-analysis of prospective trials reporting marginal bone loss with one-year follow-up was also reported.

Key Study Factor
The key interventions were the timing of implant placement following extraction and the timing of implant loading after implant placement. Comparisons following greater than one-year follow-up were made between implants with immediate placement with immediate loading, immediate/early placement with conventional loading, conventional placement with immediate/early loading, or conventional placement with conventional loading.

Main Outcome Measure
The main outcome was implant survival. Radiographically determined peri-implant bone level change was also reported. Meta-analyses were completed using studies that reported one-year implant survival data (15 studies) and more than one-year implant survival data (11 studies). One-year marginal bone level data were analyzed for implants treated conventionally (5 studies). For survival and marginal bone levels, weighted rates and random effects models were used to calculate overall effects of the included studies. For greater than one-year follow-up, survival data were stratified by intervention type. Results were weighted for study size and stratified based upon timing of implant placement and loading. Esthetics, and patient satisfaction, and complications were reported, but heterogeneity of study design and reported outcomes excluded the results from meta-analysis.

Main Result
Approximately two-thirds of patients received implants in healed edentulous sites. Survival of single-tooth implants one year in function was 95.5% [95% CI: 93.0–97.1]. Meta-analysis identified no difference in survival rate at one year when the results were weighted for study size and stratified based upon timing of implant
placement and loading. Survival of single-tooth implants more than one year in function ranged from 92.4% [95% CI: 84.4 –96.4] for conventional placement with immediate loading to 97.5% [95% CI: 88.399.5] for immediate placement with immediate loading. The third meta-analysis identified 0.20-mm [95% CI: 0.034–0.36] marginal bone loss for implants one year in function. Qualitative interpretation of other esthetic, patient satisfaction, and complication outcomes revealed no difference in immediate, early, or conventional therapy approaches.

Conclusions
The authors concluded that implant-supported single-tooth replacement in the aesthetic zone with adjacent natural teeth can lead to short-term, favorable outcomes with regard to implant survival and marginal bone level change with early/immediate or conventional surgical placement and loading strategies.

COMMENTARY AND ANALYSIS
Patient expectations of rapid, predictable therapies that meet their esthetic and functional desires have led to more rapid implant placement and loading time frames. Numerous patient prognostic factors with the variety of implant and restoration design options challenge the clinician in determining the most predictable approach to replace single teeth for a specific patient. Potential prognostic factors such as available bone volume, greater implant insertion torque, and favorable functional loading conditions have been used to identify patients for whom immediate approaches could be indicated. As with completely and partially edentulous patient groups, the most consistently documented evidence regarding patients with single edentulous sites in the esthetic region is implant survival.

Although encouraging evidence suggested predictable survival of implants using immediate/early or conventional therapeutic protocols, the greatest impact of this study relates the reader’s recognition of the paucity of higher-order evidence that supports single-tooth replacement with immediately placed or loaded implant approaches. One observes that (1) a limited number of studies exist with greater than one year follow-up that compared timings of implant placement and restoration, (2) fewer published prospective studies exist that reported single-tooth implants in function, and (3) a negligible number of prospective or retrospective studies have systematically assessed outcomes such as marginal bone levels, esthetics, patient satisfaction, and complications. The authors acknowledged the need for more, well-designed randomized controlled trials to better characterize outcomes for single-tooth implant survival and success.

Survival meta-analyses were well planned with clear identification of database search terms, clear description of study inclusion criteria, and attention to detail in coinvestigator agreement selection of studies for meta-analysis. The search strategy identified 5 randomized controlled trials, two clinical trials, and 12 case series studies pertinent to single teeth that had comparable outcome data. Surprisingly, the term “Dental Implants, Single-Tooth” [MeSH] was not employed. Authors temporally identified two groups for survival analysis: one year and more than one year after loading. These time periods were likely selected because the preponderance of studies reported one-year post-loading follow-up. Temporal stratification at two years and more than two years may, however, best identify early failure incidence, because the greatest rates of implant failure after surgical placement have been generally reported within that period. As more studies report survival beyond one year of loading, focused meta-analyses with cumulative data at one year, two years, and beyond will provide a more complete understanding of single-tooth implant early survival.

Results obtained in this meta-analysis are comparable to those reported in Cochrane Collaboration systematic reviews. One Cochrane review assessed timing of implant placement in 96 similar single-implant patients and suggested no statistically significant differences in prosthesis or implant failures. A second Cochrane review assessed timing of implant loading, but evidence was not limited to single teeth and did not focus on the aesthetic zone. Thirty RCTs were identified in 22 studies with 976 participants, and no statistically significant difference was identified based upon timing of loading.

Survival results obtained in this meta-analysis are also comparable to systematic reviews that included prospective and retrospective data, but these reviews were not limited to single teeth in the esthetic zone. Implant survival rates at 60 months have been reported as 95.1% [95% CI: 92.2 –98.0] and 94.2% [95% CI: 92.0 –96.4]. A third single-implant meta-analysis reported 6-year single-implant survival of 97% [95% CI: 96% –98%]. Another review reported similar survival data for immediate-, early-, and late-placed implants, but meta-analytical comparisons were deemed inappropriate due to study design heterogeneity. In general, this larger body of survival evidence could be used to supplement decision making in the esthetic region. However, results would not directly apply to patients with anterior edentulous sites, as analyses were not limited by site, timing of placement, loading conditions, and other additional potentially critical prognostic factors.

Contradictions in outcomes among studies underscore the need for cautious optimism for the planning of single-tooth implant restorations. A meta-analysis of 629 single implants in the esthetic zone showed immediately placed and restored protocols had greater risk of implant failure. Five studies with > 60 subjects who received immediately
placed/loaded implants showed failure 3.57 times greater [95% CI: 1.02 – 12.53] compared to healed sites with immediate loading. Although statistically not significant, follow-up of > 18 months suggested the potential for increased failure risk (RR = 4.84 [95% CI: 0.89 – 20.16]) regardless of study size. Broad confidence intervals reflected patient variability among studies and confirmed the need for more investigation.

Marginal bone loss reports among studies also shows wide-ranging variation, yet few studies contain similar data for analysis. The reported mean bone loss of 0.20 mm in this meta-analysis was consistent with information published in the Cochrane review that identified two studies comparing marginal bone levels in immediately versus conventionally loaded implants. These studies, which were not single-implant populations, identified bone loss of 0.1 mm to 0.8 mm after one year. Conversely, a recent meta-analysis of two one-year studies of anterior implants in the esthetic zone suggested that bone levels adjacent to immediately placed/immediately loaded implants was improved (mean = 1.96 mm [95% CI: 1.20, 2.73]) compared to immediate loading in healed sites. Study standard deviations two to three times greater than their means again underscored variability in patient responses. Further investigation is necessary.

Additional prospective studies may now provide relevant data. Crespi and co-workers reported 100% implant survival and 1-mm mean marginal bone loss after 24 months with 40 immediately loaded implants placed in single extraction or healed sites in the esthetic zone. A multicenter randomized controlled trial by Donati and co-workers also reported survival and marginal bone loss data after immediate placement and loading. Twelve-month survival, largely on maxillary premolar sites with immediate loading (153 Astra Tech implants/144 total patients), was 94.5% (osteotome technique) and 98% (standard technique) compared to 100% for conventional placement and loading. Marginal bone loss (mean = 0.31 mm) occurred primarily in the first 3 months after implant placement regardless of placement timing. Variability within and between studies again serves as a reminder that timing of implant placement or timing of loading are two of many factors that influence outcomes in the esthetic zone.

Patient perceived outcomes are arguably most important for successful patient care, but these outcomes have been documented unsystematically across studies. Credible analytic comparison in this study was impossible. Patient satisfaction with esthetics and function has been measured directly using OHIP survey instruments, and might be predicted by indirect measurement of perimplant soft and hard tissue changes. Future research documenting single-tooth implant restorations must be consistent, within CONSORT guidelines, and focus upon patient satisfaction and quality-of-life issues supplemented by clinician-reported, esthetics-related outcomes. Papillae indices, marginal bone change, and marginal soft tissue change may be useful, but validation of assessments in relation to clinician and patient expectations is necessary.

The best therapy approach for single-implant restorations in the esthetic zone will be achieved by ongoing broad and detailed documentation with interrelated and validated outcome measures. Available short-term documentation, although limited, seems to support the judicious selection of single-unit implant restorations as an option for the esthetic zone. Results in this study and others reinforce the need to clarify and moderate patient expectations during a thoughtfully informed consent process due to variability in treatment results, especially when rapid therapy protocols for implant placement and loading are considered.

REFERENCES


