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EVIDENCE REPORT »

A COMPARISON OF BONE GRAFTS WITH AND WITHOUT PLATELET-RICH PLASMA IN PREPARATION FOR DENTAL IMPLANT PLACEMENT

EVIDENCE REPORT »

A COMPARISON OF ENDOSSEOUS DENTAL IMPLANT DESIGNS WITH AND WITHOUT MICROTHREADED NECKS

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- **Literature Analyses** provide you with an in-depth look at the research on a given topic. A «Literature Analysis» is a critical review of the literature on the epidemiology, treatment methods, and prognosis for implant-related topics or conditions. Literature Analyses are broader than «Evidence Reports» and are written to serve as a reference tool for implantologists to help them make decisions regarding how to manage patients, to assist them in evaluating needs for future research, and to use the material for future presentations.
- **Critical Appraisals** summarize the findings from important papers used for clinical decision making or marketing by implant companies. In addition to the summary, the study's methods and clinical conclusions are critically reviewed in an effort to challenge the implantology community into not accepting everything that is published, while fostering alternative explanations and ideas.
- **Case reports** give implantologists the opportunity to publish on unique patients using innovative or alternative methods for treating challenging patient conditions.
- **Research in Context** is a helpful «what is» section to consult if you've ever read a study and asked «what is a p-value» or any other research method question. It assists clinicians with the critical evaluation of the literature by briefly describing relevant aspects of research methods and statistical analysis that may bias results and lead to erroneous conclusions.

A comparison of bone grafts with and without platelet-rich plasma in preparation for dental implant placement

Authors:

Dr. Stefan Ihde
Lindenstr. 68
CH-8738 Uetliburg/SG
Switzerland
Mail: dr.ihde@implant.com

Dr. Antonina Rusak
v. Choruzdey Str. 34a-37
BY-220123 Minsk
Belarus
Mail: dr.rusak@mail.ru

Evidence Report for Implant Directions

Evidence Report Purpose

Sinus and ridge augmentation is often utilized prior to placement of endosseous implants in the edentulous upper jaw. Bone grafts are used in such procedures to enhance sites deficient in bone quality or quantity, and attention has focused on accelerating bone regeneration and improving wound healing. Recent efforts to improve wound healing have concentrated on autogenous sources of bioactive mediators, such as platelet-rich plasma (PRP), which offer the potential to enhance the biological activity of bone replacement grafts.

Objective

To critically summarize the recently published literature examining bone characteristics (quality, resorption/gain) and other outcomes in

studies of bone grafts placed with and without platelet-rich plasma in preparation for intraoral dental implant placement.

Summary

One study reported no significant differences in implant survival rates between implants placed in bone grafts with PRP compared to bone grafts alone (rag). One study found a significantly greater bone density in bone augmented with autologous bone plus PRP compared to the bone without PRP group, while another study did not find any differences in bone density when comparing the two groups. There were no significant differences in trabecular bone volumes in one study or in vertical dimension of bone in another study. Two studies found an increased, though nonsignificant, increase in percentage of vital bone in histologic specimens of bone augmented with PRP compared to the non-PRP treated sites. Studies were of moderate quality so conclusions based on reported differences should be considered with caution. Additional methodologically rigorous comparative studies with comparable characteristics between groups are needed to better evaluate the effect of PRP associated with bone grafts upon treatment outcomes.

Sampling

A MEDLINE search was performed to identify recent studies published between January 2005 and July 2009 examining treatment outcomes of bone grafts placed with versus without platelet-rich plasma in preparation for dental implant placement. Three articles met our criteria, evaluating the treatment comparison of interest, and are included in this report, Table 1.

Table 1. Medline Search Summary

Terms	Hits	Reviewed
Search dental implants OR dental implantation, endosseous [MeSH]	19,009	
Search (dental implants OR dental implantation, endosseous [MeSH]) AND alveolar ridge augmentation AND comparative study, Limits ENGLISH, Human, Literature containing Abstracts	117	3
Bibliographies from existing literature	0	0
Total Reviewed		3

Common Outcome Measures

- Implant survival
- Bone density
- Bone quantity
- Bone quality

Interventions

In preparation for intraoral dental implantation, sinus augmentation and bone grafts placed with and without platelet-rich plasma were performed and were described as follows:

Consolo (2007)

- Sixteen patients with bilateral symmetrical maxillary sinus pneumatization with corresponding alveolar atrophy underwent bilateral sinus floor augmentation, randomized to autologous (iliac crest) bone on one side and PRP plus autologous bone contralaterally. Implants were inserted 4, 5, 6, and 7 months after surgery in patients randomized into four implant placement groups. Subjects were followed for 7 months following augmentation.

Kassolis (2005)

- Ten subjects underwent bilateral sinus

augmentation and were randomized to receive freeze-dried bone allograft (FDBA) plus PRP one side or FDBA plus resorbable membrane on the other. Core biopsy specimens were obtained and implants were placed 4.5 to 6 months after augmentation surgery.

Raghoobar (2005)

- Five patients with severe atrophy of the edentulous posterior maxilla underwent bilateral sinus augmentation with autologous iliac crest bone. Patients received the bone graft with PRP on one side, and bone grafting without PRP was performed on the other side in a randomized fashion. After 3 months of healing, endosseous dental implants were placed and bone biopsies were obtained.

Table 2. Comparative studies evaluating bone grafts placed with vs. without PRP in preparation for intraoral dental implant placement.

Author (year)	Study Design	Population	Diagnostic Characteristics	Implant Placement		Follow-up (%)	LoE*
				Bone Grafts with PRP	Bone Grafts without PRP		
Consolo (2007)	RCT	N=16 female: 69% age: 47 ± 5.9 (37-57) yrs	Maxillary sinus augmentation required prior to implant placement	N=16	N=16	7 months: NR†	Moderate
Kassolis (2005)	RCT	N=10 female: NR age: NR	Maxillary sinus augmentation required prior to implant placement	N=10	N=10	4.5-6 months: NR†	Moderate
Raghoobar (2005)	RCT	N=5 female: 60% age: 58.4 ± 1.9 (57-62) yrs	Edentulous, severely resorbed maxilla requiring bone augmentation prior to implant placement	N=5; Ni=3	N=5; Ni=3	20.2 ± 4.3 months: NR†	Moderate

N=number of subjects; Ni=number of implants

*Level of Evidence (LoE) is based on study design and methods (Very high, High, Moderate, and Poor)

†NR (not reported) = for follow-up rate either not reported or precise follow-up rate could not be determined since the initial number of eligible patients or number lost to follow-up were not provided.

Table 3. Evaluation of articles comparing studies evaluating bone grafts placed with vs. without PRP.

Study design and methods	Consolo (2007)	Kassolis (2005)	Raghoobar (2005)
1. What type of study design?	RCT	RCT	RCT
2. Statement of concealed allocation?*	YES	YES	YES
3. Intention to treat?*	YES	YES	YES
4. Independent or blind assessment?	NO	NO	NO
5. Complete follow-up of >85%?	NO	NO	NO
6. Adequate sample size?	NO	NO	NO
7. Controlling for possible confounding?	YES	YES	YES
LEVEL OF EVIDENCE	Moderate	Moderate	Moderate

* Applies to randomized controlled trials only

Implant survival

- Implant survival was 100% for implants placed in bone augmented without PRP and was 93.3% for implants placed in bone augmented with PRP after a mean follow-up time of 20.2 months. [Raghoobar]

Bone density

- The basal bone densitometric values of sinuses were significantly greater in the autologous bone plus PRP compared to the bone only group at 7 months after sinus floor augmentation (mean values in Hounsfield units [HU]: 500 ± 40.8 HU vs. 392.5 ± 61.9 HU, respectively; $p < .05$). Longitudinal analysis showed significantly greater bone densitometry among months 4 through 7 for the bone plus PRP group (+71% at 4 months, +81% at 5 months, +48% at 6 months, +29% at 7 months; $p < .05$), Figure 1. [Consolo]

- The average bone density on microradiographs, measured with arbitrary gray values, at the first premolar and first molar regions were 91 ± 23.1 and 71.8 ± 23.8 at the PRP side and 84.6 ± 19.6 and 90.7 ± 13.5 at the non-PRP side, respectively ($p > .05$). [Raghoobar]

Bone quantity (resorption/gain)

- There were no significant differences in mean trabecular bone volumes between the autologous bone plus PRP site compared to the bone alone site at 7 months ($p > .05$). [Consolo]

- The vertical dimension from the crest of the ridge to floor of the sinus was comparable after grafting with FDBA plus membrane and FDBA plus PRP 4.5-6 months after augmentation (13.2 ± 1.3 mm vs. 13.9 ± 2.1 mm, respec-

tively, $p > .05$). [Kassolis]

Bone quality (histology)

- Histologic specimens at 4.5-6 months following the augmentation procedure revealed a significantly greater percentage of vital tissue (bone and connective tissue) in subantral spaces grafted with FDBA and PRP than with FDBA alone ($78.8\% \pm 8.3\%$ vs. 63.0% vs. 15.7% , respectively; $p = .01$). [Kassolis]

- Further, a greater, though not statistically significant, percentage of vital bone was found in the subantral spaces grafted with FDBA and PRP than with FDBA plus membrane ($33.3 \pm 11.3\%$ vs. $26.5 \pm 6.8\%$, respectively; $p > .05$), Figure 2. [Kassolis]

- In histologic specimens taken at 3 months after the augmentation procedure, the average area occupied by bone in the augmented regions were $41.1 \pm 8.3\%$ at the non-PRP treated side and $38.4 \pm 11.3\%$ at the PRP side ($p > .05$), Figure 2. [Raghoobar]

Methodological considerations

- All studies reviewed were randomized controlled trials with a rating of moderate (low quality randomized controlled trials) level of evidence. No very high quality randomized controlled trials or high quality cohort studies were identified in the literature.

- All three studies had sample sizes that were likely inadequate to show a difference between the study groups for some of the outcomes measured.

- Since multiple implants in the same subject are not statistically independent, either one implant should be chosen per patient or statisti-

cal analysis should account for multiple implants per patient.

- None of the studies reported a follow-up rate. A follow-up rate of $\geq 85\%$ is necessary to ensure valid study results. Further, the length of follow-up for all studies was likely not adequate to assess long-term study outcomes.

References

Studies

Study 1

Consolo U, Zaffe D, Bertoldi C, Ceccherelli G (2007)

Platelet-rich plasma activity on maxillary sinus floor augmentation by autologous bone
Clin Oral Impl Res 18:252-62.

Study 2

Kassolis JD, Reynolds MA (2005)

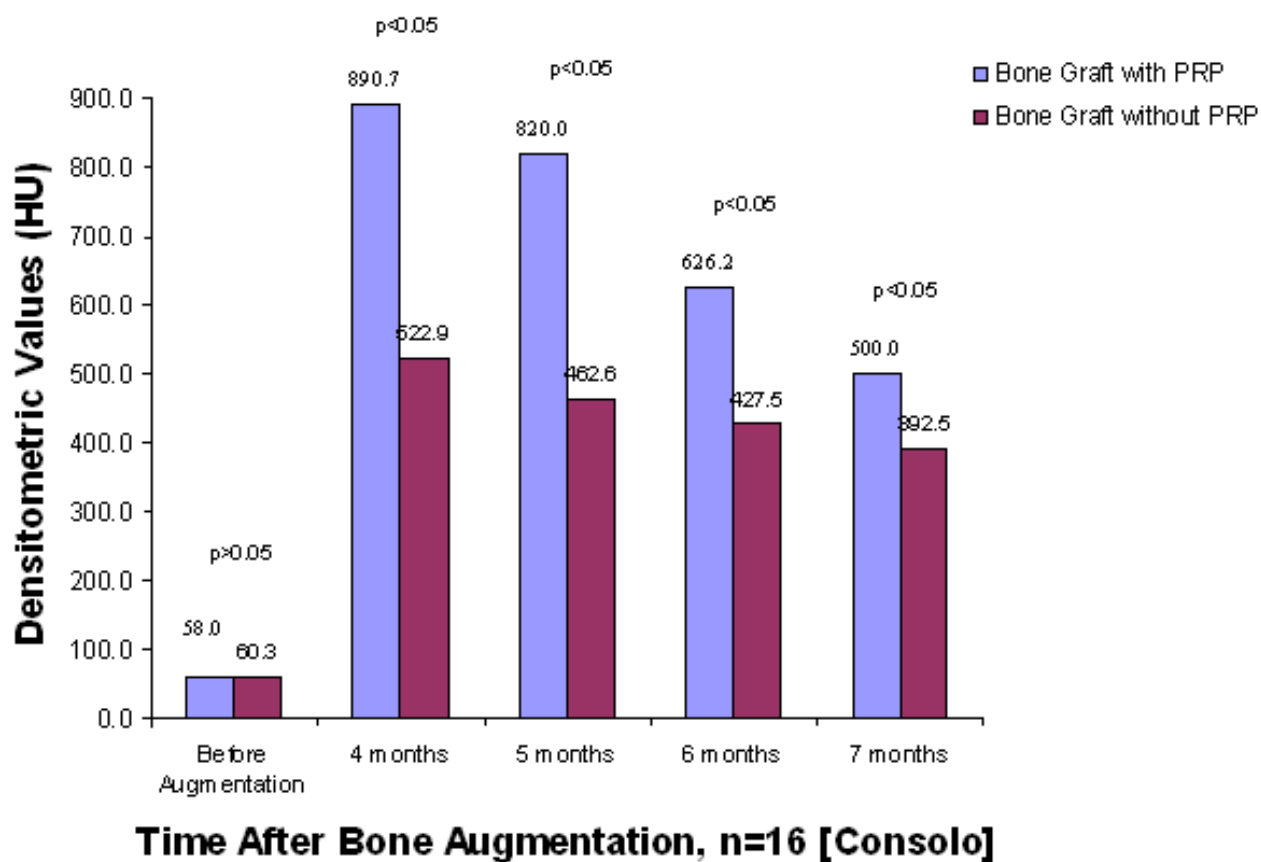
Evaluation of the adjunctive benefits of platelet-rich plasma in subantral sinus augmentation
The Journal of Craniofacial Surgery 16(2):280-7.

Study 3

Raghoobar GM, Schortinghuis J, Leim RSB, Ruben JL, van der Wal JE, Vissink A (2005)

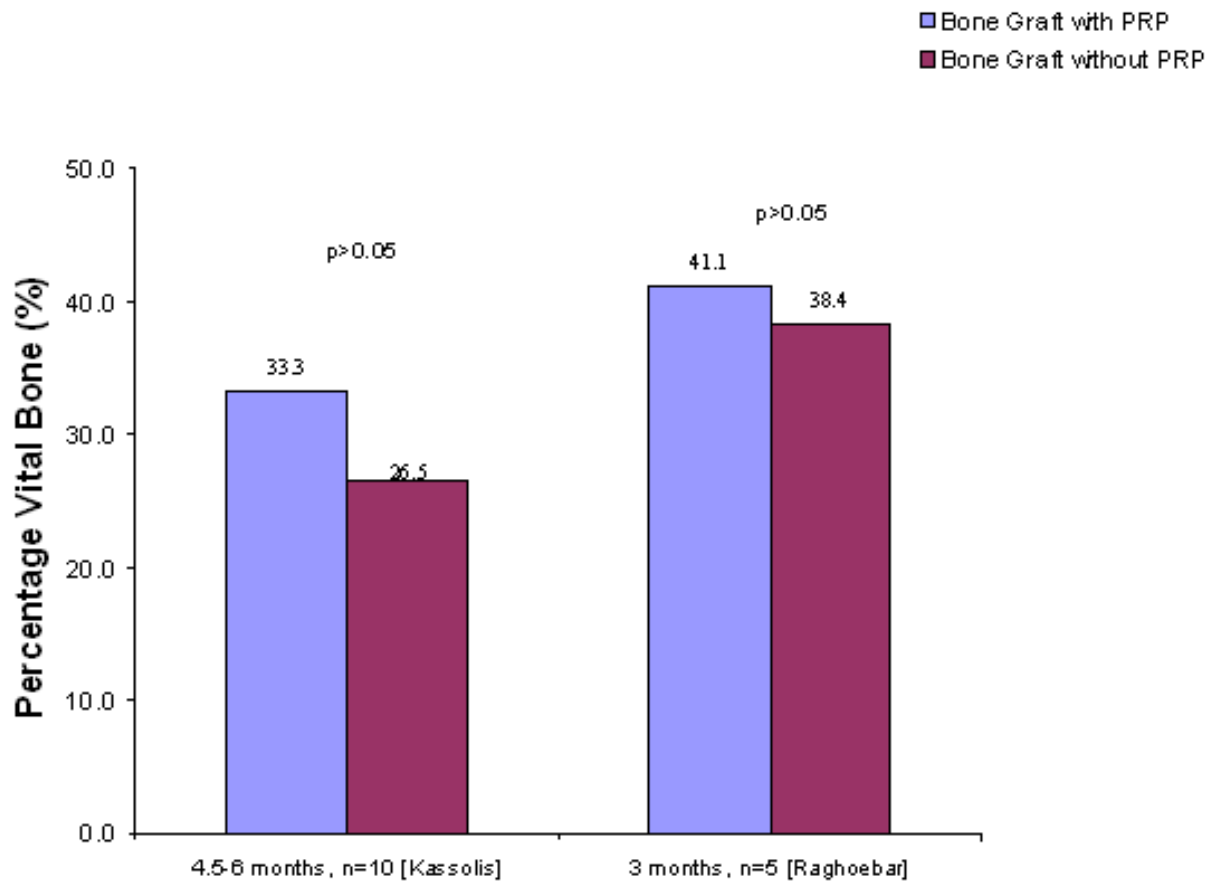
Does platelet-rich plasma promote remodeling of autologous bone grafts used for augmentation of the maxillary sinus floor?
Clin Oral Impl Res 16:349-56.

Figure 1. Changes in basal bone densitometric values for bone grafts placed with PRP compared to bone grafts placed without PRP in preparation for intraoral dental implant placement.



Statistical significance noted on graphs if provided by author

Figure 2. Percentage vital bone in histologic specimens for bone grafts placed with PRP compared to bone grafts placed without PRP in preparation for intraoral dental implant placement.



Statistical significance noted on graphs if provided by author

A comparison of endosseous dental implant designs with and without microthreaded necks

Author:

Dr. Antonina Rusak
V.Choruzhej Str. 34a – 37
220123 Minsk
Belarus
Mail: dr.rusak@mail.ru

Purpose of the Report

Long-term survival of endosseous dental implants is dependent on the preservation of bone support, and initial breakdown of the implant-tissue interface generally begins at the crestal region. It has been reported that the crestal marginal bone level changes occur during the early phase of healing as an adaptation of the peri-implant bone to the occlusal load. Literature has suggested that implant designs and surface characteristics affect rates of early bone loss. It has also been suggested that the introduction of retention grooves (microthreads) at the neck of the implant may reduce the amount of bone loss following implant placement, and that completely polished and thin mucosa penetration areas may prevent peri-implantitis and thereby bone loss.

Objective

To critically summarize the recently published literature examining marginal bone loss or bone gain and other outcomes around endosseous implants in studies comparing threaded to non-threaded implants.

Summary

One study reported no significant differences in implant survival rates between endosseous implants with microthreads compared to those without microthreads after one year of function. Two studies reported the greatest levels of marginal bone loss in implants with machined necks (no microthreads) compared to rough surfaced implants with microthreads. Two studies compared three implant designs and reported the greatest levels of marginal bone loss associated with machined necks (no microthreads), followed by rough surface necks (no microthreads), and lowest levels of bone loss in rough surfaced implants with microthreads. An additional supplemental case series was included that demonstrated an increase in bone growth in contrast to the others which demonstrated bone loss illustrating that BOI implants provide a reasonable alternative to other non-threaded implants. Studies were of moderate to high quality so conclusions based on reported differences should be considered with caution. Additional methodologically rigorous comparative studies with comparable characteristics between groups and longer follow-up are needed to better evaluate the effect of treatment outcomes in implant designs with microthreaded necks compared to no microthreads.

Sampling

A MEDLINE search was performed to identify recent studies published between January 2006 and October 2009 examining treatment outcomes in studies comparing threaded vs. non-threaded implant designs. Four articles met our criteria, evaluating the treatment comparison of interest, and are included in this re-

port, Table 1.

Terms	Hits	Reviewed
Search dental implants OR dental implantation, endosseous [MeSH]	19,455	
Search (dental implants OR dental implantation, endosseous [MeSH]) AND surface properties AND comparative study, Limits ENGLISH, Human, Literature containing Abstracts	319	4
Bibliographies from existing literature	0	0
Total Reviewed		4

Common Outcome Measures

- Implant survival
- Marginal bone loss
- Implant stability

Interventions

Dental implants with different implant designs were compared and were described as follows:

Bratu (2009)

- A prospective study was conducted in 46 patients indicated for placement of two neighboring implants in the posterior mandible received: a) one implant with a 1-mm polished neck and no retention grooves, and b) one implant with a roughened surface and microthreads at the neck. Other implant characteristics (taper, titanium alloy with moderately rough surface) were the same for both implants.

Nickenig (2009)

- In a split mouth study, thirty-four patients with bilaterally edentulous posterior mandibles randomly received implants with a machined neck on one side and implants with a microthreaded neck on the contralateral side. Sub-

jects were followed for 2 years after functional loading.

Piao (2009)

- Fifty-four patients randomly received implants with either: a) a rough surface (TiUnite Branemark MK III), b) a machined surface in the coronal part and a rough surface in the apical part of the fixture (Restore), or c) a rough surface with microthreads (Hexplant Oneplant). Subjects were followed for 1 year after implant loading.

Shin (2006)

- In a prospective study, 68 patients were randomized to receive implants with either: a) a machined neck (Ankylos), b) a rough-surfaced neck (Stage 1), or c) a rough-surfaced neck with microthreads (Oneplant). Subjects were followed for 1 year after implant loading.

Ihde (2003)

- This prospective case series included 81 patients who received 120 basal implants and were followed for 18 months. The mean age of

these patients was 61.5 years (range, 29-80) and 64% were female. This was included in the results section of this evidence report to provide data on an alternative non-threaded dental implant. There was no comparison group so superiority cannot be established; however, the results with respect to bone changes over time were remarkable enough to present as an alternative.

Author (year)	Study Design	Population	Diagnostic Characteristics	Implant Placement			Follow-up (%)	LoE *
				Rough surface, with microthreads	Rough surface, no microthreads	Machined surface, no microthreads		
Bratu (2009)	Prospective cohort	N=46 female: NR age: 23-65 yrs	Indication for implant placement of two neighboring implants in the same arch of the posterior mandible	N=46; Ni=46		N=46; Ni=46	12 months: 96%	High
Nickenig (2009)	RCT	N=34; Ni=133 female: NR age: 45,2 (25-55) yrs	Bilateral edentulous posterior mandibles with indication for implant placement	N=34; Ni=70		N=34; Ni=63	Median 1.9 (1.9-2.1) years: NR†	High
Piao (2009)	RCT	N=54; Ni=135 female: 39% age: 36-78 yrs	Indication for dental implant placement	N=21; Ni=45	N=17; Ni=45	N=16; Ni=45	12 months: NR†	High
Shin (2006)	RCT	N=68 female: NR age: NR	Indication for dental implant placement	N=NR; Ni=38	N=NR; Ni=34	N=NR; Ni=35	12 months: NR†	Moderate

N=number of subjects; Ni=number of implants

* Level of Evidence (LoE) is based on study design and methods (Very high, High, Moderate, and Poor)

†NR (not reported) = for follow-up rate either not reported or precise follow-up rate could not be determined since the initial number of eligible patients or number lost to follow-up were not provided.

Table 3. Evaluation of articles comparing endosseous implant designs with vs. without microthreaded necks.

Study design and methods	Bratu (2009)	Nickenig (2009)	Piao (2009)	Shin (2006)
1. What type of study design?	Prospective cohort	RCT	RCT	RCT
2. Statement of concealed allocation?*	N/A	YES	YES	NO
3. Intention to treat?*	N/A	NO	NO	NO
4. Independent or blind assessment?	NO	NO	NO	NO
5. Complete follow-up of $\geq 85\%$?	YES	YES	YES	YES
6. Adequate sample size?	YES	YES	YES	YES
7. Controlling for possible confounding?	YES	YES	YES	YES
LEVEL OF EVIDENCE	High	High	High	Moderate

* Applies to randomized controlled trials only

Results

Implant survival

- Implant survival was 100% for both polished neck and microthreaded neck implants after 1 year of function. [Bratu]

Marginal bone loss (Figure 1 and Figure 2)

- Marginal bone loss measured with digitized panoramic radiographs was significantly greater for polished neck compared to microthreaded neck implants after 4 months ($0.77 \pm 0.46\text{mm}$ vs. $0.21 \pm 0.19\text{mm}$, respectively, $p < .05$), after 6 months ($1.20 \pm 0.44\text{mm}$ vs. $0.56 \pm 0.23\text{mm}$, respectively, $p < .05$), and after 12 months of function ($1.47 \pm 0.40\text{mm}$ vs. $0.69 \pm 0.25\text{mm}$, respectively, $p < .05$). [Bratu]
- Marginal bone loss measured with digitized panoramic radiographs was significantly greater for machined surface (mean 1.1mm , range $0\text{-}3\text{mm}$) compared to rough surface, microthreaded (mean 0.5mm , range $0\text{-}2.1\text{mm}$) implants ($p < .001$) after a median of 1.9 years of function. [Nickenig]
- Mean marginal bone loss measured with digital intraoral periapical radiographs was greatest for machined surface implants ($0.89 \pm 0.41\text{mm}$), followed by rough surface ($0.81 \pm 0.27\text{mm}$), followed by microthreaded implants ($0.42 \pm 0.25\text{mm}$) after 1 year of functional loading (significantly different machined vs. microthreaded and rough vs. microthreaded, $p < .0001$). [Piao]
- Marginal bone loss was greatest for machined neck implants ($1.32 \pm 0.27\text{mm}$), followed by rough surface ($0.76 \pm 0.21\text{mm}$), followed by microthreaded implants ($0.18 \pm 0.16\text{mm}$) after 1 year of functional loading ($p < .05$). [Shin]

Bone growth (Figure 1)

- The study by Ihde was the only study that reported vertical bone growth under function. The mean growth was 1.9mm (range, $0.2\text{mm}\text{-}6\text{mm}$). No subjects exhibited bone loss. All implants were immediately loaded. Data was accessed only from the distal mandible.

Implant stability

- Implant stability, measured with the PerioTest, was significantly lower (better) for microthreaded neck compared to polished neck implants at 4 months after implant placement (-6.5 vs. -5 , respectively; $p = 0.04$). [Bratu]

Methodological considerations

- Three studies reviewed were randomized controlled trials with a rating of high (moderate quality randomized controlled trials) level of evidence, and one study was a prospective cohort study with a rating of moderate (moderate quality cohort study) level of evidence. No very high quality randomized controlled trials or high quality cohort studies were identified.
- All four studies had sample sizes that were adequate to show a difference between the study groups for some of the outcomes measured.
- The supplemental study by Ihde was a case series without a comparison group; therefore, superiority cannot be established. However, it was the only study in this group with an increase in bone growth in contrast to bone loss. It has to be mentioned, that studies on BOI which include a control group (e.g. with screw type implants) are not found at all in literature,

because BOI implants are used mostly in cases where one would not find enough vertical bone for conventional implant types without augmentation. This eliminates the possibility of observing a true control group.

- Since multiple implants in the same subject are not statistically independent, either one implant should be chosen per patient or statistical analysis should account for multiple implants per patient. This did not occur in the three studies for which multiple implants were placed in the same patient. In the supplemental study by Ihde one implant per side was included into the study.

References

Studies

Study 1

Bratu EA, Tandlich M, Shapira L (2009)

A rough surface implant neck with microthreads reduces the amount of marginal bone loss: a prospective clinical study

Clin Oral Impl Res 20:827-32.

Study 2

Nickenig HJ, Wichmann M, Schlegel KA, Nkenke E, Eitner S (2009)

Radiographic evaluation of marginal bone levels adjacent to parallel-screw cylinder machined-neck implants and rough-surfaced microthreaded implants using digitized panoramic radiographs

Clin Oral Impl Res 20:550-54.

Study 3

Piao CM, Lee JE, Koak JY, Kim SK, Rhyu IC, Han CH, Herr Y, Heo SJ (2009)

Marginal bone loss around three different implant systems: radiographic evaluation after 1 year

Journal of Oral Rehabilitation 36:748-54.

Study 4

Shin YK, Han CH, Heo SJ, Kim S, Chun HJ (2006)

Radiographic evaluation of marginal bone level around implants with different neck designs after 1 year

Int J Oral Maxillofac Implants 21(5):789-94.

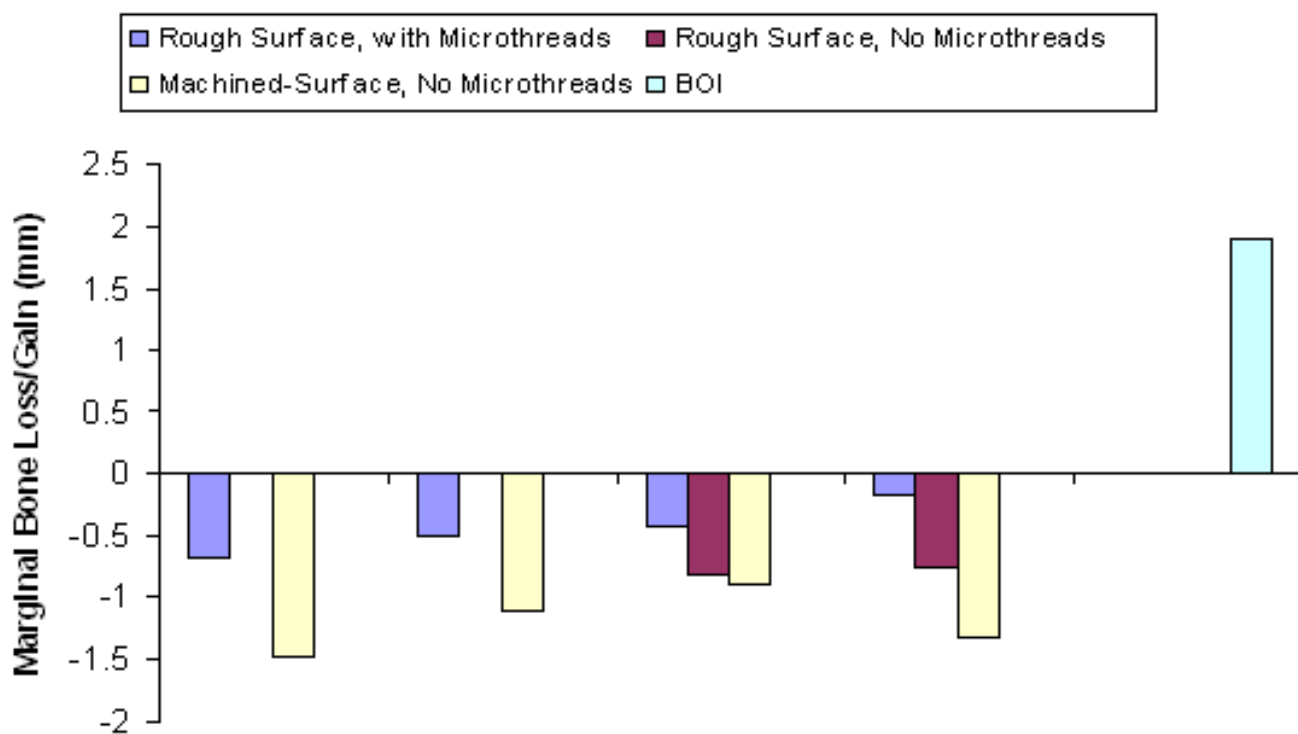
Supplemental study

Ihde S

Adaptation fonctionelles de la hauteur de l'os peri-implantaire apre implantation de BOI dans la mandibule

Implantodontie 12(2003) 23-33

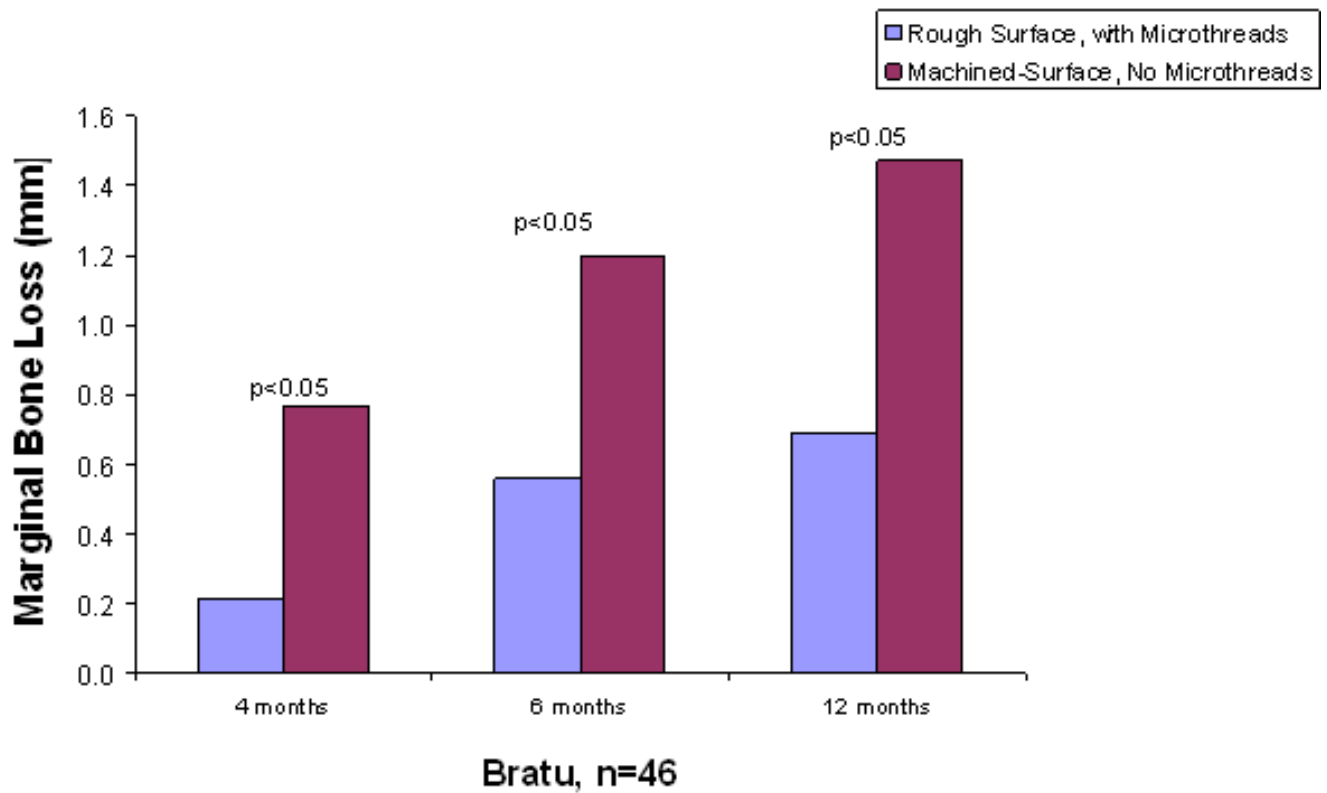
Figure 1. Mean marginal bone loss for endosseous dental implant designs with microthreaded necks compared to implants without microthreads.



Statistical significance noted on graphs if provided by author

* $p < .001$ rough surface, with microthreads vs. rough surface, no microthreads AND
 $p < .001$ rough surface, with microthreads vs. machined surface, no microthreads

Figure 2. Mean marginal bone loss over time for endosseous dental implant designs with micro-threaded necks compared to implants with machined necks and no microthreads.



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