TwinLight™ Periodontal Treatment

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Zdravstveni dom
dr. Adolfa Drolca Maribor

REVIEW OF THE LITERATURE

American Academy of Periodontology Statement on the Efficacy of Lasers in the Non-Surgical Treatment of Inflammatory Periodontal Disease*

The American Academy of Periodontology (AAP) periodically publishes reports, statements, and guidelines on a variety of topics relevant to periodontics. These papers are developed by an appointed committee of experts, and the documents are reviewed and approved by the AAP Board of Trustees.

Clinical application of lasers for the treatment of periodontal disease has continued to expand since their introduction for this purpose in the early 1990s[1-9] but remains controversial.[1,10-18] The primary purpose of this statement is to provide an evidence-based perspective on three of the purported benefits of using lasers in the non-surgical treatment of periodontal disease, i.e., sulcular and/or pocket debridement (a.k.a. laser curettage), reduction of subgingival bacterial loads (a.k.a. pocket sterilization), and scaling and root planing (SRP).

LASER-MEDIATED SULCULAR AND/OR POCKET DEBRIDEMENT

If one considers the clinical parameters of reductions in probing depth or gains in clinical attachment level, the dental literature indicates that when used as an adjunct to SRP, mechanical, chemical, or laser curettage has little to no benefit beyond SRP alone.[10-17] The available evidence consistently shows that therapies intended to arrest and control periodontitis depend primarily on effective debridement of the root surface and not removal of the lining of the pocket soft tissue wall, i.e., curettage.[18,19] Currently, there is minimal evidence to support use of a laser for the purpose of subgingival debridement, either as a monotherapy or adjunctive to SRP.[10-22]

REDUCTION OF SUBGINGIVAL BACTERIAL LEVELS

Current evidence shows lasers, as a group, to be unpredictable and inconsistent in their ability to reduce subgingival microbial loads beyond that achieved by SRP alone.[10-17] Further, this conclusion also appears to apply to the use of photodynamic therapy (PDT), either as a monotherapy or adjunctive to SRP.[23] At best, the evidence is lacking or conflicting. For example, of the 10 published clinical trials, only two showed PDT to be effective in reducing subgingival microbial loads, four reported no difference, and four did not measure reductions in microbes.[17]

SCALING AND ROOT PLANING

Erbium lasers show the greatest potential for effective root debridement (SRP). The Er:YAG laser has been shown, in vitro, to remove calculus[12] and to negate endotoxin.[12,15,24,25] There is the potential for root surface damage during the process of in vivo calculus removal since the Er:YAG is a hard tissue laser and the operator would not be able to visualize what is being lased. Clinical data on attachment level changes when compared to SRP alone are conflicting, with some studies showing a slight benefit while others show no benefit. Further study is needed to determine if laser-assisted SRP has a beneficial effect.

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*This statement was developed under the direction of the Workgroup to Develop Statement on Laser Use by Dental Professionals and approved by the Board of Trustees of the American Academy of Periodontology in November 2010.

doi: 10.1902/jop.2011.114001

The available evidence consistently shows that therapies intended to arrest and control periodontitis depend primarily on effective debridement of the root surface and not removal of the lining of the pocket soft tissue wall, i.e., curettage.18,19

Currently, there is **minimal evidence to support use of a laser for the purpose of subgingival debridement**, either as a monotherapy or adjunctive to SRP.10-22

Current evidence shows **lasers**, as a group, to be **unpredictable and inconsistent in their ability to reduce subgingival microbial loads** beyond that achieved by SRP alone.10-17

Erbium lasers show the greatest potential for effective root debridement (SRP). The Er:YAG laser has been shown, in vitro, to remove calculus12 and to negate endotoxin.12,15,24,25

There is the **potential for root surface damage** during the process of in vivo calculus removal .....

Clinical data on **attachment level changes** when compared to SRP alone are conflicting, with some studies showing a **slight benefit** while others show **no benefit.**

Further study is needed to determine if laser-assisted SRP has a beneficial effect.

Lasers Med Sci
DOI 10.1007/s10103-011-0928-8

REVIEW ARTICLE

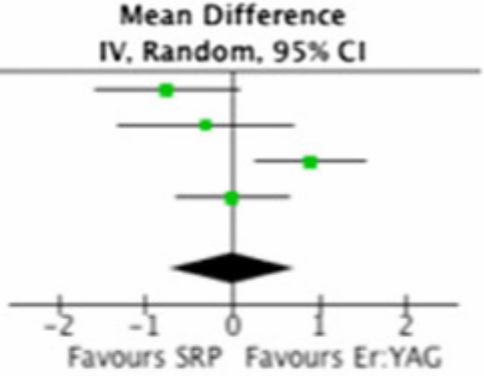
Efficacy of Er:YAG laser in the treatment of chronic periodontitis: systematic review and meta-analysis

Fabrizio Sgolastra · Ambra Petrucci · Roberto Gatto · Annalisa Monaco

Clinical Attachment Level Gain at 6 months

Study or Subgroup	Er:YAG Mean	Er:YAG SD	Er:YAG Total	SRP Mean	SRP SD	SRP Total	Weight	Mean Difference IV, Random, 95% CI
Lopes et al. 2010	0.6	1.21	19	1.35	1.41	19	24.0%	-0.75 [-1.59, 0.09]
Rotundo et al. 2010	0.2	1.9	26	0.5	1.8	26	20.9%	-0.30 [-1.31, 0.71]
Schwarz et al. 2001	1.9	1.05	20	1	1	20	27.7%	0.90 [0.26, 1.54]
Sculean et al. 2004	1.11	1.01	20	1.11	1.09	20	27.4%	0.00 [-0.65, 0.65]
Total (95% CI)			**85**			**85**	**100.0%**	**0.01 [-0.72, 0.73]**

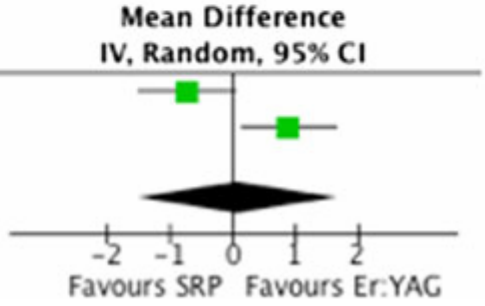
Heterogeneity: $Tau^2 = 0.39$; $Chi^2 = 10.75$, df = 3 (P = 0.01); $I^2 = 72\%$
Test for overall effect: Z = 0.02 (P = 0.99)



Clinical Attachment Level Gain at 12 months

Study or Subgroup	Er:YAG Mean	Er:YAG SD	Er:YAG Total	SRP Mean	SRP SD	SRP Total	Weight	Mean Difference IV, Random, 95% CI
Lopes et al. 2010	0.68	1.1	19	1.41	1.3	19	50.0%	-0.73 [-1.50, 0.04]
Schwarz et al. 2003	1.8	1.21	20	0.9	1.24	20	50.0%	0.90 [0.14, 1.66]
Total (95% CI)			**39**			**39**	**100.0%**	**0.09 [-1.51, 1.68]**

Heterogeneity: $Tau^2 = 1.18$; $Chi^2 = 8.78$, df = 1 (P = 0.003); $I^2 = 89\%$
Test for overall effect: Z = 0.11 (P = 0.92)



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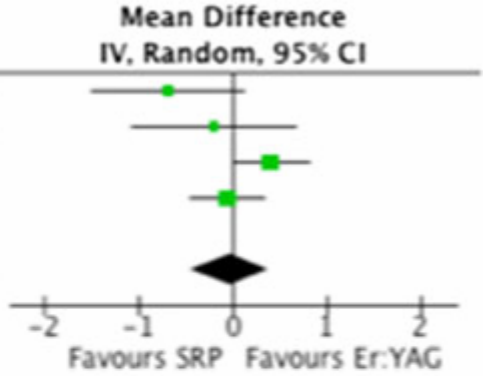
Probing Depth Reduction at 6 months

Study or Subgroup	Er:YAG Mean	Er:YAG SD	Er:YAG Total	SRP Mean	SRP SD	SRP Total	Weight	Mean Difference IV, Random, 95% CI
Lopes et al. 2010	1.54	1.21	19	2.23	1.34	19	17.1%	-0.69 [-1.50, 0.12]
Rotundo et al. 2010	0.7	1.66	26	0.9	1.51	26	15.8%	-0.20 [-1.06, 0.66]
Schwarz et al. 2001	2	0.65	20	1.6	0.65	20	33.3%	0.40 [-0.00, 0.80]
Sculean et al. 2004	1.52	0.57	20	1.57	0.69	20	33.8%	-0.05 [-0.44, 0.34]
Total (95% CI)			**85**			**85**	**100.0%**	**-0.03 [-0.45, 0.38]**

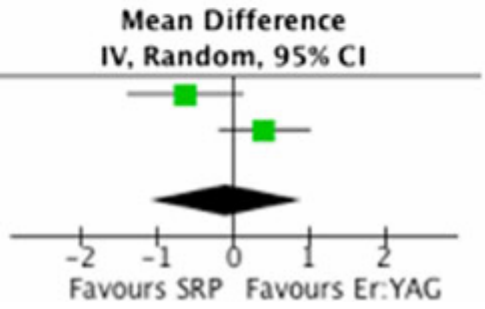
Heterogeneity: $Tau^2 = 0.09$; $Chi^2 = 6.66$, df = 3 (P = 0.08); $I^2 = 55\%$
Test for overall effect: Z = 0.16 (P = 0.88)



Probing Depth Reduction at 12 months

Study or Subgroup	Er:YAG Mean	Er:YAG SD	Er:YAG Total	SRP Mean	SRP SD	SRP Total	Weight	Mean Difference IV, Random, 95% CI
Lopes et al. 2010	1.66	1.15	19	2.29	1.21	19	47.4%	-0.63 [-1.38, 0.12]
Schwarz et al. 2003	1.9	0.75	20	1.5	1.12	20	52.6%	0.40 [-0.19, 0.99]
Total (95% CI)			**39**			**39**	**100.0%**	**-0.09 [-1.10, 0.92]**

Heterogeneity: $Tau^2 = 0.41$; $Chi^2 = 4.47$, df = 1 (P = 0.03); $I^2 = 78\%$
Test for overall effect: Z = 0.17 (P = 0.86)



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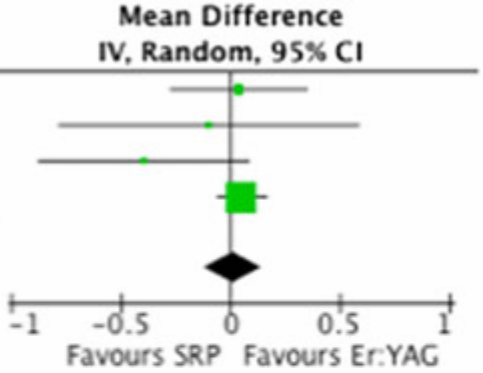
Gingival Recession Changes at 6 months

Study or Subgroup	Er:YAG Mean	Er:YAG SD	Er:YAG Total	SRP Mean	SRP SD	SRP Total	Weight	Mean Difference IV, Random, 95% CI
Lopes et al. 2010	0.61	0.37	19	0.57	0.59	19	16.0%	0.04 [-0.27, 0.35]
Rotundo et al. 2010	-0.6	1.31	26	-0.5	1.21	26	3.6%	-0.10 [-0.79, 0.59]
Schwarz et al. 2001	0.1	0.75	20	0.5	0.8	20	7.2%	-0.40 [-0.88, 0.08]
Sculean et al. 2004	-0.41	0.16	20	-0.46	0.2	20	73.1%	0.05 [-0.06, 0.16]
Total (95% CI)			**85**			**85**	**100.0%**	**0.01 [-0.12, 0.14]**

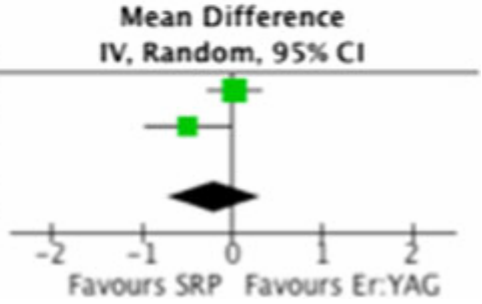
Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 3.33$, df = 3 (P = 0.34); $I^2 = 10\%$
Test for overall effect: Z = 0.15 (P = 0.88)



Gingival Recession Changes at 12 months

Study or Subgroup	Er:YAG Mean	Er:YAG SD	Er:YAG Total	SRP Mean	SRP SD	SRP Total	Weight	Mean Difference IV, Random, 95% CI
Lopes et al. 2010	0.56	0.35	19	0.53	0.57	19	55.8%	0.03 [-0.27, 0.33]
Schwarz et al. 2003	0.1	0.75	20	0.6	0.75	20	44.2%	-0.50 [-0.96, -0.04]
Total (95% CI)			**39**			**39**	**100.0%**	**-0.20 [-0.72, 0.31]**

Heterogeneity: $Tau^2 = 0.10$; $Chi^2 = 3.52$, df = 1 (P = 0.06); $I^2 = 72\%$
Test for overall effect: Z = 0.78 (P = 0.44)



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Total (95% CI)			**85**			**85**	**100.0%**	**0.01 [-0.12, 0.14]**

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 3.33$, df = 3 (P = 0.34); $I^2 = 10\%$
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Favours SRP Fav

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Schwarz et al. 2003	0.1	0.75	20	0.6	0.75	20
Total (95% CI)			**39**			**39**

Heterogeneity: $Tau^2 = 0.10$; $Chi^2 = 3.52$, df = 1 (P = 0.06); $I^2 = 7$
Test for overall effect: Z = 0.78 (P = 0.44)

Gingival Recession Changes at 6 mo

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Lopes et al. 2010	0.61	0.37	19	0.5
Rotundo et al. 2010	-0.6	1.31	26	-0
Schwarz et al. 2001	0.1	0.75	20	0
Sculean et al. 2004	-0.41	0.16	20	-0.4
Total (95% CI)			**85**	

Heterogeneity: $Tau^2 = 0.00$; $Chi^2 = 3.33$, df = 3
Test for overall effect: Z = 0.15 (P = 0.88)

Clinical Attachment Level Gain at 12 months

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Favours SRP Favours Er:YAG

"Future long-term, well-designed RCTs are needed to assess the scientific evidence of Er:YAG laser efficacy as an alternative treatment strategy to SRP."

LITERATURE REVIEW
REMOVAL OF SUBGINGIVAL CALCULUS

- Nd:YAG
  - Ineffective
    - Tseng & Liew, 1990
  - Thermal damage of the pulpal tissue
    - White et al., 1994
- Er:YAG
  - Effective without major thermal damage
    - Aoki et al., 1994
  - Selective to a level equivalent to SRP
    - Schwarz et al.,2003
  - Histologically no adverse effects in the pulp tissue
    - Mizutani et al.,2006
  - Lower degree of calculus removal
    - Eberhard et al.,2003

LITERATURE REVIEW
BACTERICIDIAL AND DETOXIFICATION EFFECTS

- Nd:YAG
  - **Effective** decontamination
    - White et al., 1991
  - **Inactivation** of endotoxins
    - Fukuda et al., 1994

- *Aggregatibacter actinomycetemcomitans,*
- *Porphyromonas gingivalis,*
- *Prevotella intermedia,*
- *Tannerella forsythia,*
- *Fusobacterium nucleatum*
- *Parvimonas micra*
- Nd:YAG laser 6 W, 50 Hz, 250 μs
- After 15, 30 in 45 s **no living bacteria**
  - Kranendonk et al., 2010

LITERATURE REVIEW
BACTERICIDIAL AND DETOXIFICATION EFFECTS

- Er:YAG
  - Bactericidial effect at low energy level
    - Ando et al., 1996, Folwaczny et al.,2002
  - Removal of endotoxins
    - Schwarz et al.,1997

- Er:YAG laser **removes bacteria** from dentin **equally effective** as SRP or US.
- **Number of CFU** after laser irradiation **significantly lower** than after SRP or US.
- Er:YAG laser removes bacteria by thermal **vaporization**.
  - Akiyama et al., 2011

LITERATURE REVIEW
BACTERICIDIAL AND DETOXIFICATION EFFECTS

Er:YAG

- **Curettes produced roughest surface comparing to laser**.
- There was a significant positive correlation between **roughness** values and **bacterial cells counts**.
  - Ota-Tsuzuki et al., 2009

- The laser affected the dentin profile, **creating a rough and irregular surface**.
- The changes induced by the laser produced a less favorable environment for cell adhesion or growth, and **treated dentin seemed to be more suitable for PLF adhesion** compared to hOB adhesion.
  - Galli et al., 2009

LITERATURE REVIEW
BACTERICIDIAL AND DETOXIFICATION EFFECTS

Er:YAG

- **Less** surface **roughness** in **short-pulse** (140μs) setting.
- Short pulses **more suitable** for micro-morphology of the root surface.
  - Hakki et al., 2010
- Short-pulse laser setup looks more **promising** regarding the **attachment, spreading,** and **orientation** of **PDL cells**.
  - Hakki et al., 2010
- Irradiation at working tip **angulations** of **45** degrees and **60** degrees produced results of **attachment** of **blood components** and ***root wear*** comparable with those obtained with manual instrumentation.
  - De Oliveira et al., 2010

LITERATURE REVIEW

HEALING

Nd:YAG

- A significant **increase in epithelial thickness** was found, suggesting increased scar tissue after wound repair;
- Long and irregular **connective tissue protrusions** projecting into the undersurface of the epithelium were noted in laser groups.
  - Demir et al., 2010

Er:YAG

- The microstructure of the root cementum surface after Er:YAG laser irradiation **hinders the early attachment of PDL cells**.
- **Chemical** and/or **mechanical** root conditioning treatment may **improve and increase the biocompatibility** of the Er:YAG laser-treated root cementum **by exposing the collagen fibers**.
  - Maruyama et al., 2008

LITERATURE REVIEW
BONE

Er:YAG

- Er:YAG laser **effectively removes bone tissue**.
- Thermal alterations of bone surface **do not disturb the regeneration process**.
  - Yoshino et al., 2009

- **Carbonized bone tissue** is absorbed during the healing proces an **serves as a bone graft**.
  - Salina et al., 2006

- Low level Er:YAG laser stimulates proliferation of osteoblasts via MAPK/ERK signaling pathway
- Enhance bone healing and regeneration.

  - Aleksic et al., 2010

LITERATURE REVIEW

PERIODONTAL POCKET TREATMENT - CLINICAL

- Nd:YAG
  - Significantly reduced post-therapy levels of bacteria
    - Ben Hatit et al., 1996
  - Significant clinical improvements and IL-1 reduction
    - Miyazaki et al., 2003
  - Significant bacterial reduction in class II furcation immediately after irradiation
    - de Andrade et al., 2008
  - Failed to improve the clinical and microbiological parameters of periodontal disease
    - Radvar et al., 1996
  - Less effective than SPR in reduction of IL-1b
    - Liu et al., 1999

LITERATURE REVIEW

PERIODONTAL POCKET TREATMENT - CLINICAL

- Nd:YAG + water cooling
  - At the 1-week and 3-month follow-up, **PD, PI**, and **GCF** volume showed **significant improvement**
  - At the 1-week and 3-month follow up, **IL-1beta** and **MMP-8** levels were **significantly reduced.**
  - SRP in combination with a single application of a water-cooled Nd:YAG laser significantly improves clinical signs associated with periodontal inflammation.
    - Quadri et al., 2010

- Nd:YAG + water cooling
  - At the 3-month visit no significant differences between treatment modalities were observed for any of the clinical parameters.
    - Slot et al., 2011

LITERATURE REVIEW

PERIODONTAL POCKET TREATMENT - CLINICAL

- Er:YAG
  - Clinical improvement similar to SRP and US results
    - Schwarz et al.,2001, Sculean et al.,2004
  - Clinical improvements could be maintained until 2 years
    - Schwarz et al.,2003
  - Clinical improvement similar to SRP and US results
    - Schwarz et al.,2001, Sculean et al.,2004
  - Better clinical results at 1 month in comparison to US
    - Tomasi et al.,2006
  - Better results than after US even after 2 years
    - Crespi et al.,2007

LITERATURE REVIEW

PERIODONTAL POCKET TREATMENT - CLINICAL

- Er:YAG
  - **GI decreased** for SRPL and increased for L, SRP, and C 12 days postoperatively.
  - SRPL and L presented a **significant reduction** in the percentage of sites with bacteria 6 and 12 months after treatment.
    - Lopes et al., 2010
  - The adjunctive use of Er:YAG laser to conventional SRP did not reveal a more effective result than SRP alone.
    - Rotundo et al., 2010
  - Laser treatment caused **less pain** than the sonic device with no difference in the treatment time.
    - Braun et al. 2010
  - SRP+ERL **decreased the levels of proinflammatory cytokines IL-1B and TNF-a** and **prevented** a fast process of **bacterial recolonization**.
    - Dominguez et al., 2010

TwinLight™ Periodontal Treatment

Randomized Clinical Study

AIM

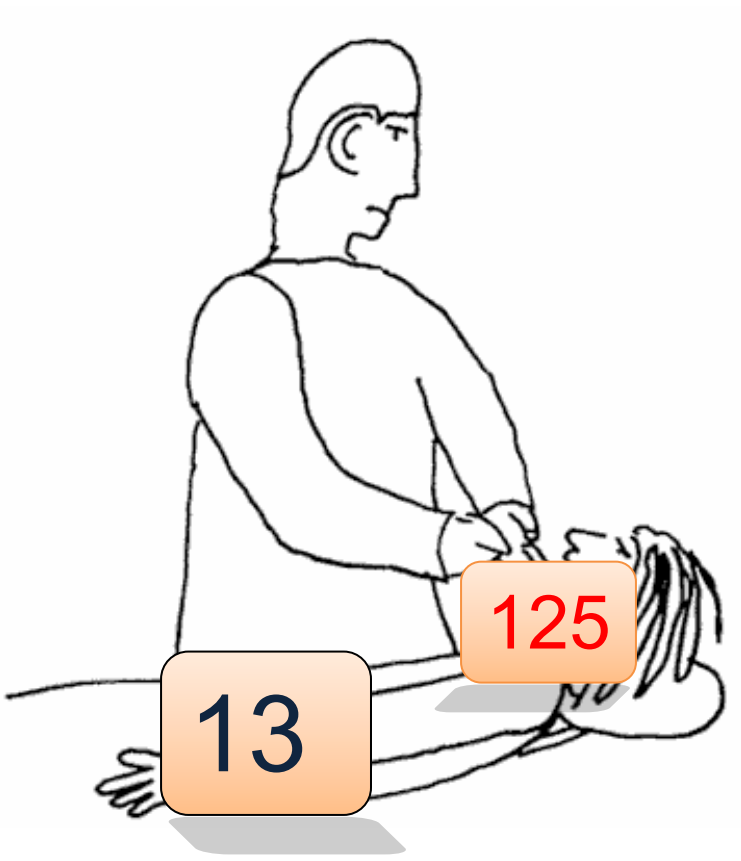
AIM

- To compare the clinical efficaciy of conventional MWF, and combined laser treatment in periodonitis patients on improvement of clinical outcame.

MATERIALS AND METHODS

MATERIALS AND METHODS
Patients

- 13 patients (125 single-rooted teeth) with advanced periodontitis
- Split-mouth design.
- Inclusion criteria:
  - PD≥ 6 mm,
  - At least 4 teeth with periodontal pockets
  - age: 40-60 years
- Exclusion criteria:
  - Smoking
  - Antibiotic treatment (6 months)

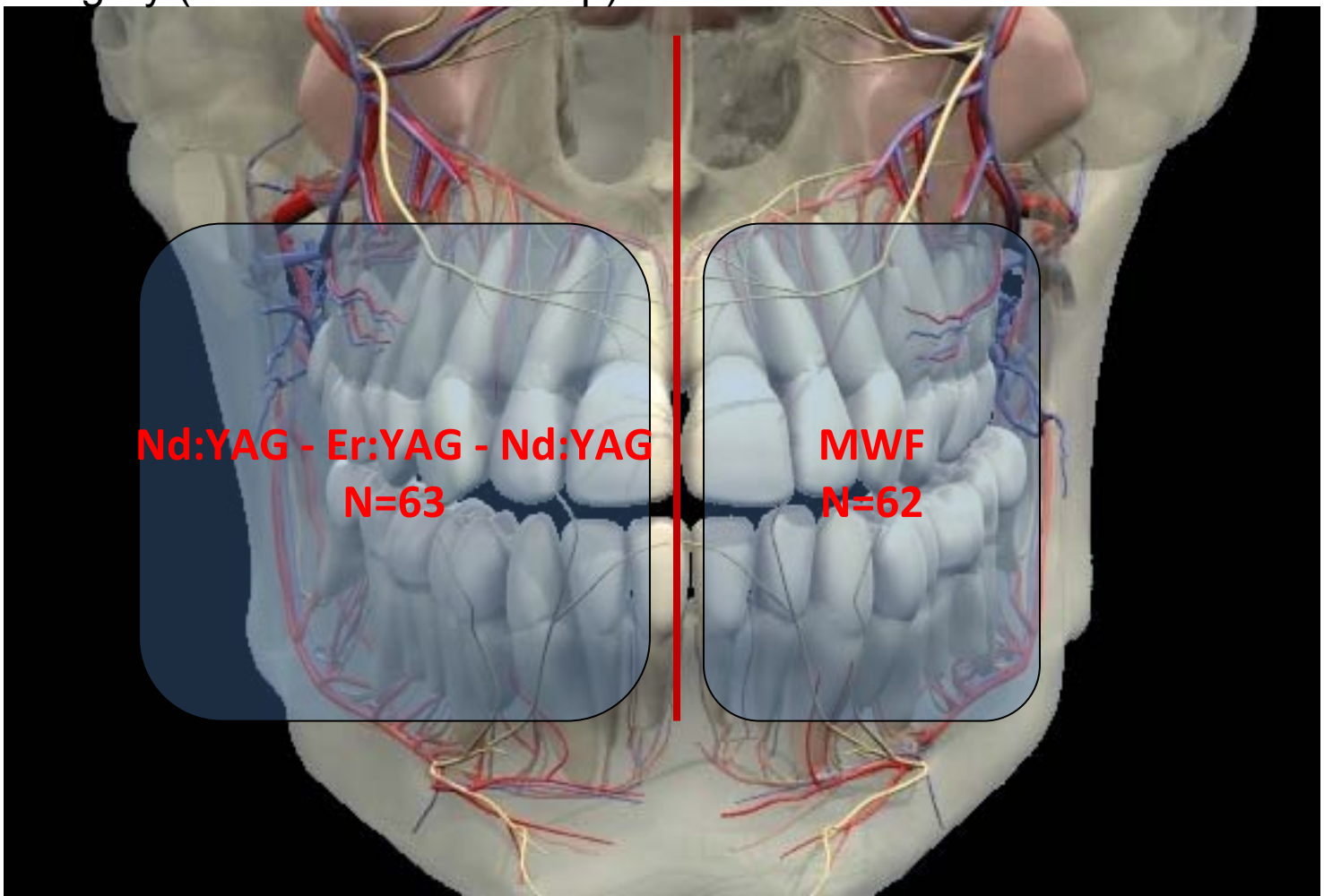


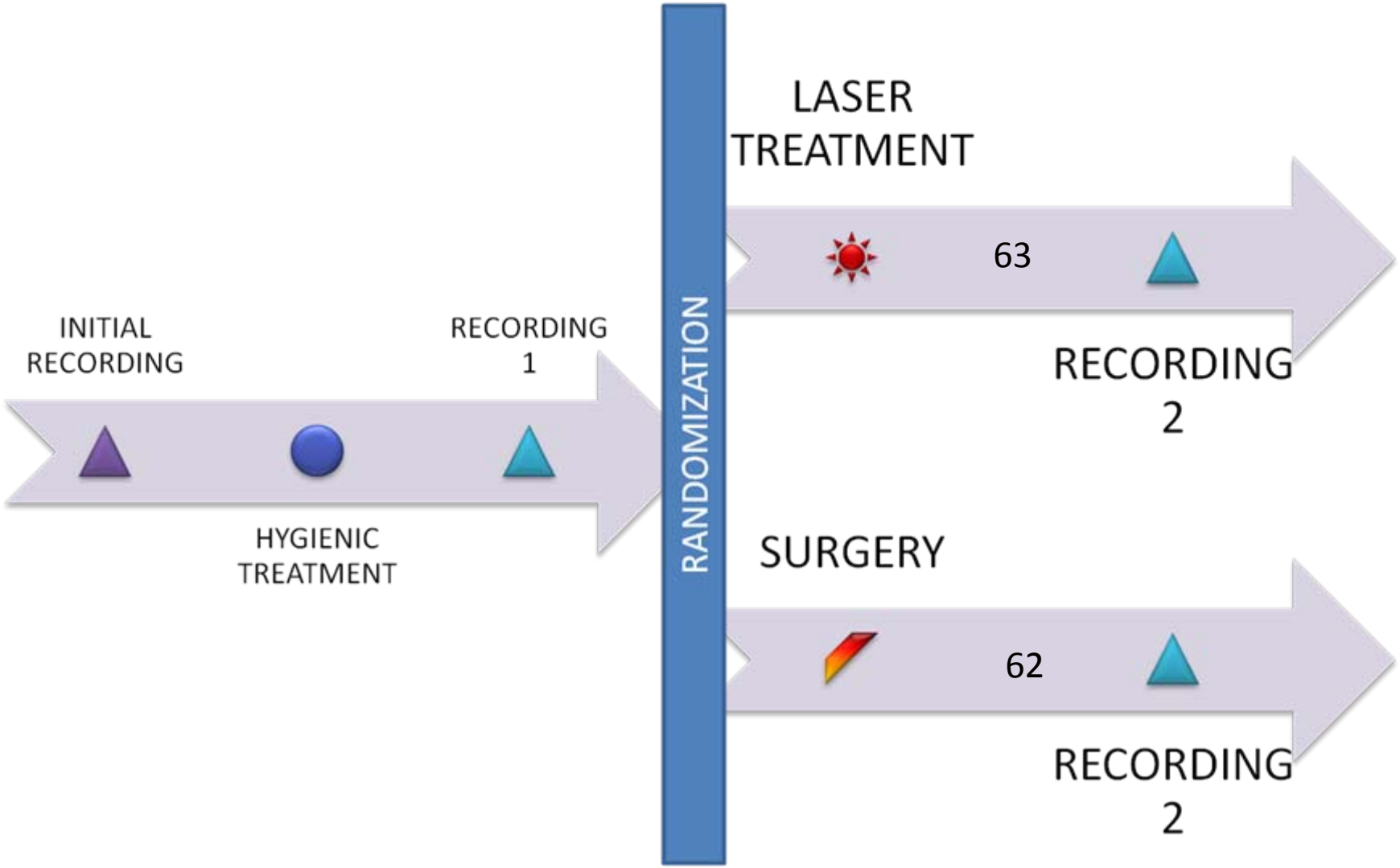
MATERIALS AND METHODS
Study design

- Monitoring:
  - Gingval recession (R)
  - Probing depth (PD)
  - Clinical attachment level (CAL)
  - Bleeding on probing score (BOP)
- At baseline and 3 months after the treatment.
- Statistics: paired t-test, Student's t-test

MATERIALS AND METHODS
Study design

Test group received combined Nd:YAG - Er:YAG – Nd:YAG laser treatment, while control group received conventional access flap surgery (modified Widman flap).




INITIAL RECORDING
HYGIENIC TREATMENT
RECORDING 1
RANDOMIZATION
LASER TREATMENT
63
RECORDING 2
SURGERY
62
RECORDING 2

MATERIALS AND METHODS
Procedures

Laser was used to:

1. **Nd:YAG** :debride the periodontal pockets (MSP, 4 W, 20 Hz),
2. **Er:YAG** : scale the root surface and remove coagulated content of the periodontal pocket and adjacent soft tissue (SP, 50 mJ/pulse, 40 Hz)
3. **Nd:YAG** : stabilize the blood clott inside periodontal pocket (VLP, 3.5 W, 20 Hz).

MATERIALS AND METHODS
Procedures

Clinically healthy

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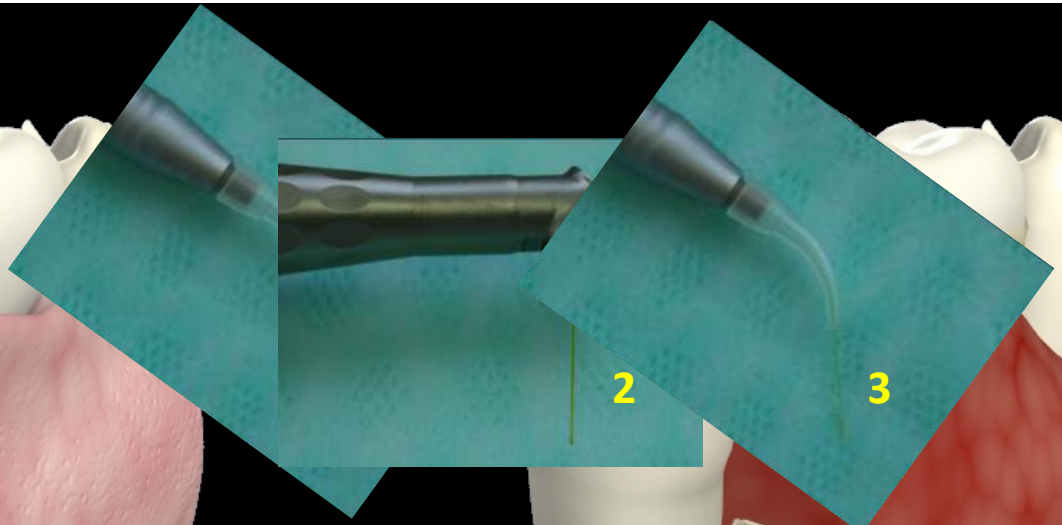
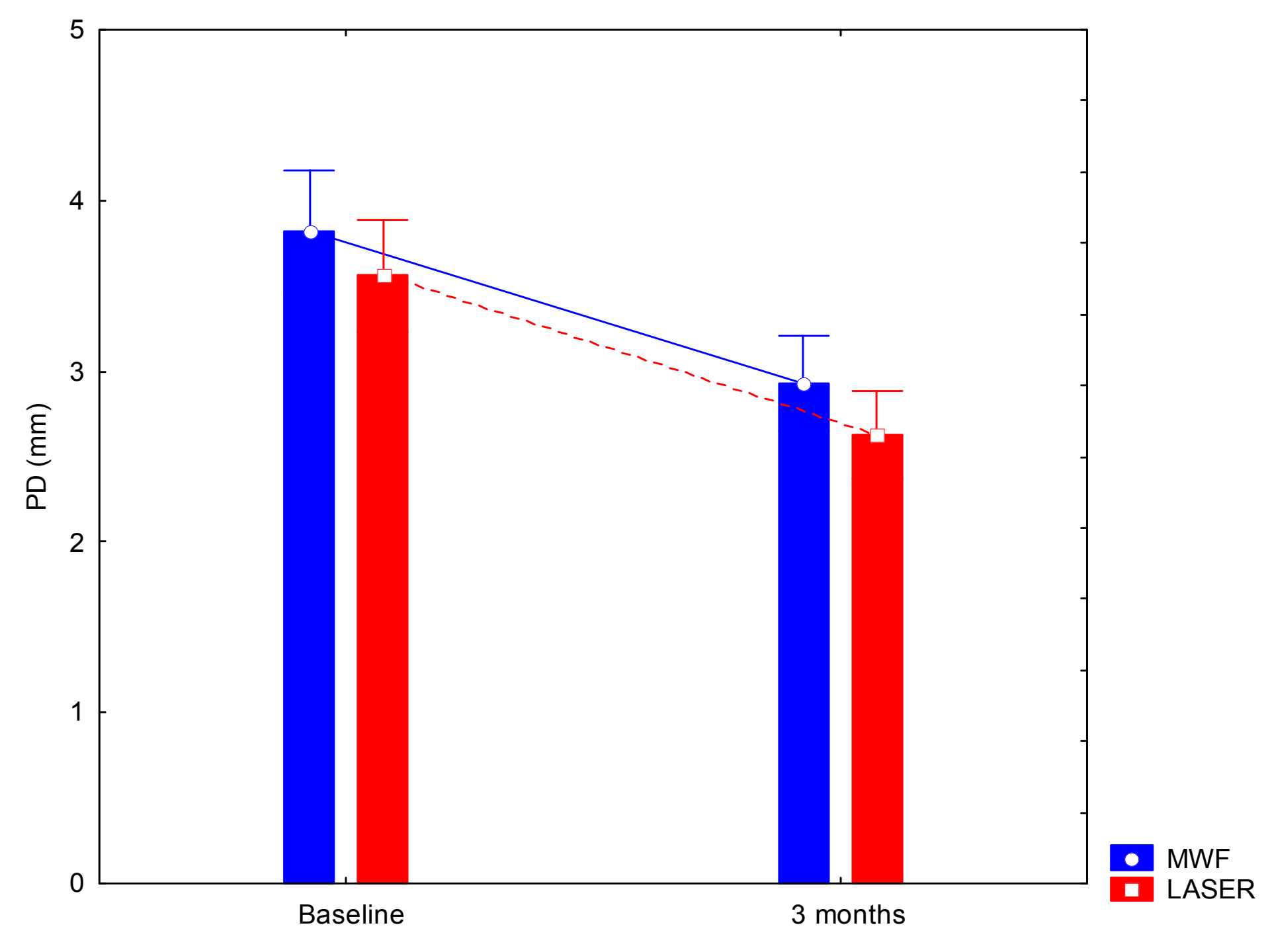
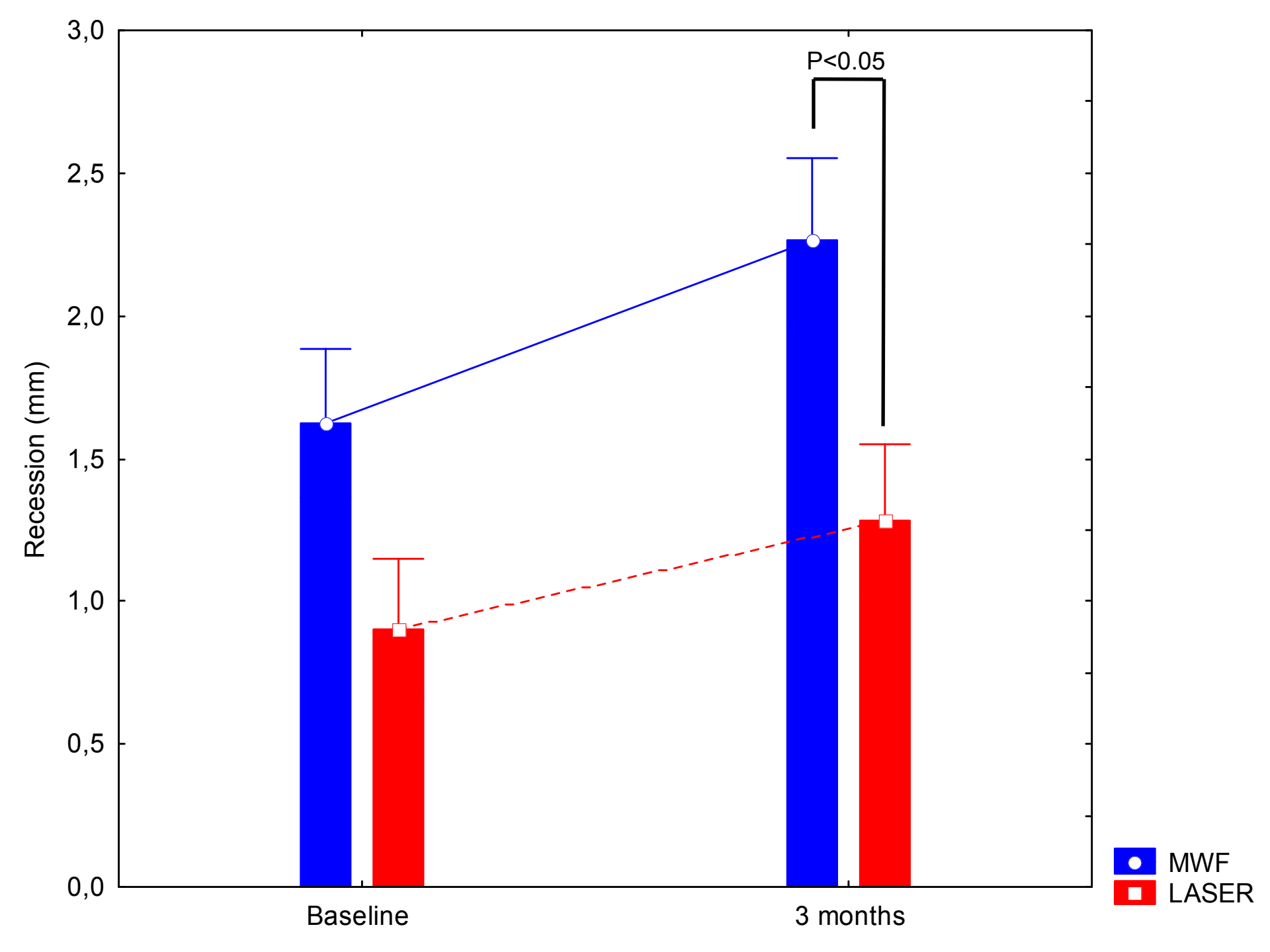
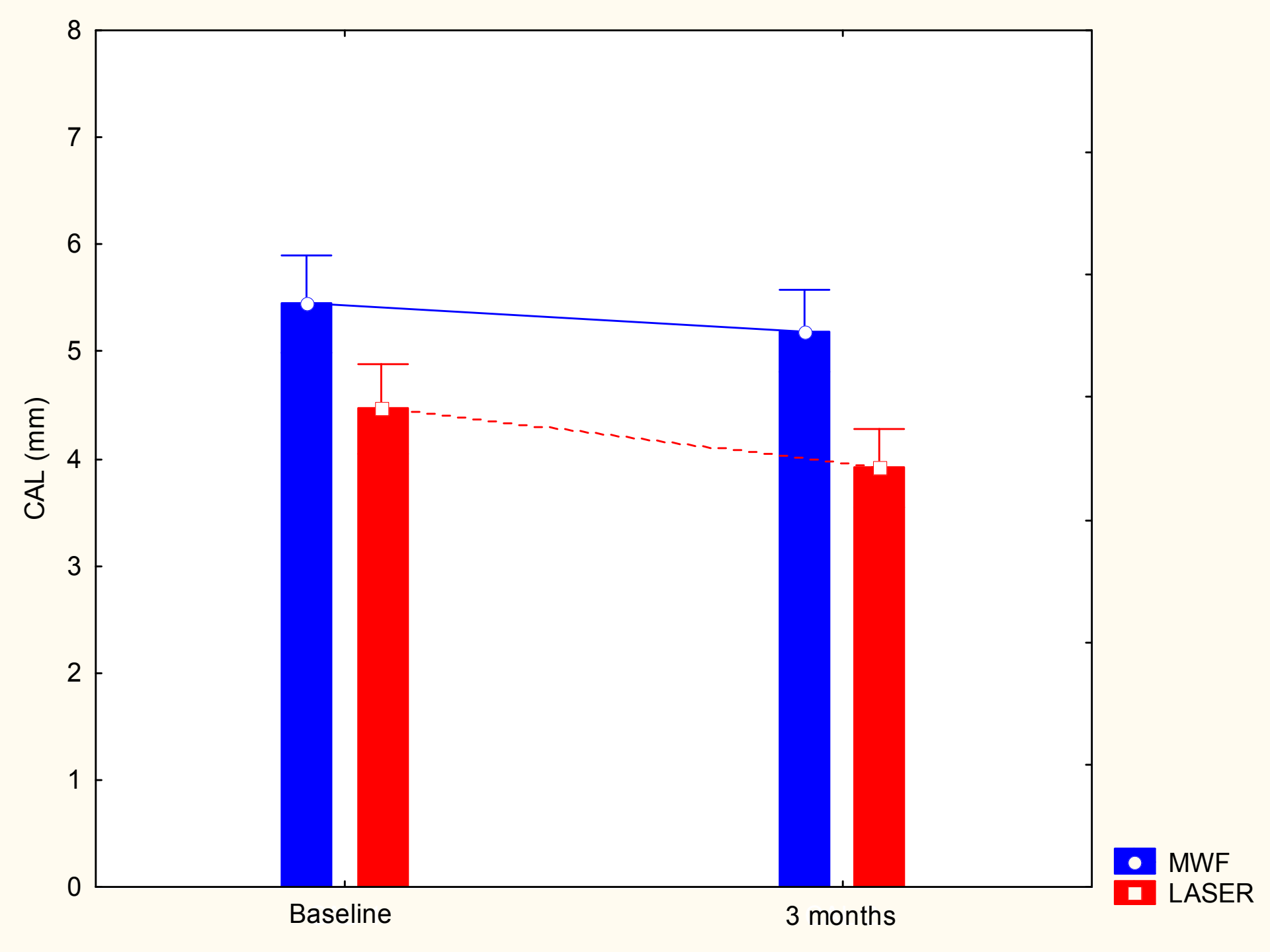


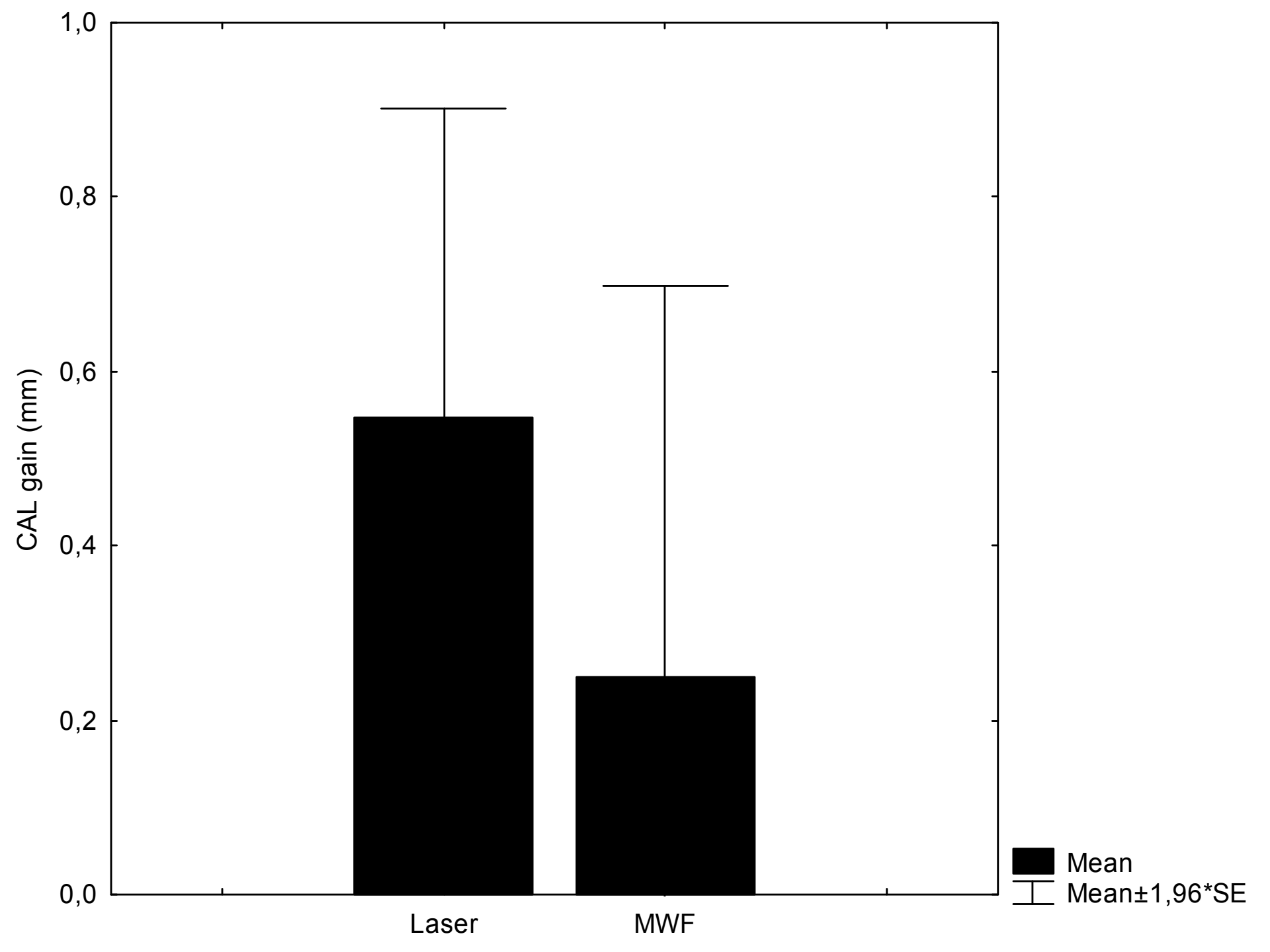
Periodontitis

RESULTS


5
4
3
2
1
0
PD (mm)
Baseline
3 months
MWF
LASER


3,0
2,5
2,0
1,5
1,0
0,5
0,0
Recession (mm)
P<0.05
Baseline
3 months
MWF
LASER


8
7
6
5
4
3
2
1
0
CAL (mm)
Baseline
3 months
MWF
LASER


1,0
0,8
0,6
0,4
0,2
0,0
CAL gain (mm)
Laser
MWF
Mean
Mean±1,96*SE

CONCLUSIONS

- Results of pilot clinical study suggest the possibility of the use of **TwinLight™ Periodontal Treatment (**Nd:YAG + Er:YAG laser) in treatment of advanced form of periodontal disease.

- **The results of combined laser treatment are comparable with the results of conventional surgical treatment.**

- Advantages of laser treatment are minimally invasive approach, the procedure is less time consuming, no suturing, less post operative complications.

Thank you for your attention