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Original Article

Minimally Invasive Extractions with Physics Forceps – Clinical Evaluation and Comparison

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Abstract

Introduction: Tooth extraction is still one of the most common dental procedures, routinely performed for a variety of reasons. Tooth extraction forceps and elevators are well-known extraction instruments which have been the standard in tooth extraction procedures for well over a hundred years. Physics forceps are one possible alternative, aiming to perform less traumatic and more predictable extractions.

Aim: The aim of study was to compare the effectiveness of physics forceps as an alternative, less traumatic, tool to the conventional extraction forceps.

Materials and methods: All patients in the study were split into two groups: 26 patients in whom conventional extraction forceps were used (a control group) and 28 patients in whom we used physics forceps (a study group). For each group, we assessed the success of the extraction, the buccal cortical plate preservation, pain experience, and early wound healing.

Results: There was no statistically significant difference in extraction success scores between the two groups. Physics forceps extractions preserved the buccal cortical plate in 81.1% of instances, while traditional forceps extractions did so in 71.8%. The patients in the study group reported less pain on the seventh day. At 10 days, the study group had a marginally higher proportion of completely healed extraction wounds.

Conclusions: Atraumatic extractions preserve more hard and soft tissues at the extraction site. Physics forceps are a tool similar to the well-known conventional extraction forceps. They provide for somewhat better results in most extractions.

Keywords

atraumatic, minimally invasive, physics forceps, tooth extraction

INTRODUCTION

Tooth extraction remains one of the most common dental procedures, performed for a variety of reasons.[1] Dental implantology has emerged as the preferred method of replacing missing teeth, and even teeth with questionable conservative treatment outcomes are being seriously considered for extraction and replacement. Dental implants, however, are not just placed anywhere; they frequently need to be planned and executed properly in order to remove a tooth first.[2]

Tooth extraction forceps and elevators are well-known and have served as the main tools for tooth extractions for over a century. They do not make it difficult to conduct an atraumatic extraction, but they frequently result in unforeseen complications. Even the most skilled oral surgeons may have difficulty performing certain tooth extractions. Inadequate manipulation technique and approach can

result in a wide range of postoperative abnormalities in the extraction site, affecting both hard and soft tissues.[3,4] This is why specialists are still exploring different techniques and looking for the most predictable approach.

Different criteria can be used to assess the amount of trauma caused during an extraction. However, post extraction pain is undoubtedly one of the main indicators of how much damage was caused. Normally extractions are followed by mild to no discomfort at all, but their healing can be delayed and accompanied by severe pain, as well as symptoms such as swelling, trismus, infection. All of these indicate postoperative complications, oftentimes a result of excessive trauma.[5] This, of course, leads to an expectation that less bone tissue will remain after the healing process and the soft tissue contour may be harmed.[6]

Physics forceps are an alternative tooth extraction tool, aiming to perform less traumatic and more predictable extractions. They were first introduced by Dr. Richard Golden in 2004. Unlike the conventional forceps, these tools do not rely on the luxation of the tooth and expansion of the socket. These forceps rely on the phenomenon of solid materials known as 'creep'. This is the process of a material undergoing slow deformation while subjected to persistent stress. In this way, they tear the periodontal ligament fibers and free the tooth from its retention to the socket, all the while protecting the buccal cortical plate with a silicon covered bumper.[7,8]

AIM

The aim of study was to compare the effectiveness of physics forceps as an alternative, less traumatic, tool to the conventional extraction forceps.

MATERIALS AND METHODS

Study design

This study was a crossover randomized control trial.

Subjects and sample

The study was conducted between January 2022 and December 2022. It included 54 patients who were recruited from the Department of Oral Surgery at the Faculty of Dental Medicine, in the Medical University of Plovdiv. The study was approved by the Ethics Committee of Medical University of Plovdiv with protocol P-3499/21.12.2021.

A convenience sampling method was used to select patients. The participants were split into two equal groups using block randomization assigning every next patient to the group with the least participants. Group I (control group) consisted of 26 patients who had an extraction with conventional extraction forceps and was considered the control group. Group II consisted of 28 patients who were treated with physics forceps and were considered the study group. Two patients from the study group did not turn up for the complete follow-up period and were thus excluded.

Inclusion criteria:

- Patients with teeth indicated for extraction
- Patients without contraindications for surgical intervention (ASA 1 or 2)
- Patients with good oral hygiene

Exclusion criteria:

- Patients with severe systemic conditions or immunosuppression
- Patients with acute odontogenic infections
- Drug or alcohol abuse
- Patients with psychiatric conditions
- Patients on anticoagulant or antiaggregant drugs refusing to complete prior tests and preparation for tooth extraction
- Patients on chemotherapy, radiotherapy, or oral bisphosphonate intake

Clinical procedure

Patients in the control group were treated with the conventional extraction forceps, which are taught to all dental students and are well-known among dental practitioners. Patients in the study group were treated with physics forceps, which are suggested to provide a more predictable, less traumatic extraction of teeth.

In both groups, infiltration anesthesia was applied using 4% articaine hydrochloride with adrenaline (dilution, 1:200000; Septodont, Saint-Maur-des-Fossés, France). To prevent soft tissue tearing, the tooth was freed from the gingival margin using a scalpel blade #15C. The multi-rooted teeth in both groups were not separated before the extraction began.

For the extractions with physics forceps the instrument was positioned so that the bumper would lie on the buccal side at the level of the mucogingival junction. The beak was positioned over sound hard tissues on the oral side of the tooth. The forceps were activated with a slight buccal rotation and held until the tooth came loose. Then the tooth was picked out with either a hemostat or conventional extraction forceps with no additional luxation or rotation.

Evaluation method

Extraction success assessment

Extraction success was graded from 1 to 5 based on the scale of Choi et al.[9] and its later modification by Patel et al.[10]

- Complete success (score 5): extraction without crown and root fracture.
- Limited success with root tip fracture (score 4): extraction involving root tip fracture.
- Limited success with root fracture (score 3): extraction involving root one or more root fracture or

crown fracture.
- Limited success with osteotomy (score 2): fracture-free extraction and partial osteotomy in case divergent roots and thick cortical bone was present.
- Failure (score 1): Failure to extract.

Buccal cortical plate preservation assessment

The level of the buccal cortical plate was ranked as preserved (no difference), partially preserved (<4 mm) and missing (>4 mm). The difference was measured based on the preoperative and postoperative probing distance on the buccal side of the socket. This is part of the newly suggested single-rooted extraction wound classification by Hamoun et al.[11] where they evaluate the missing buccal cortical plate in percentages.

Pain intensity assessment

Pain was scored on a linear VAS scale and measured in centimeters (10 cm total length) on the day of extraction (day 0), and days 1, 3, and 7 after the extraction. Participants were asked to place a mark on the linear scale where pain grows from left to right, based on their pain experience on the given day.

Wound healing assessment

Wound healing was assessed at 3, 7, and 10 days after the extraction. Scoring was based on Landry's index (LWHI – Landry Wound Healing Index, also known as Landry, Turnbull, and Howley index).[12] The index evaluates the extraction socket based on wound size, tissue color, bleeding on palpation, presence of granulation tissue, presence of pus, and gingival margin status.

Statistical analysis

The statistical package for Social Sciences (SPSS) v. 27 (2020) was used to analyze the data. Non-normally distributed variables were presented with median values and interquartile ranges (IQRs) and between-group comparisons were performed using the Mann-Whitney U test. The chi-square test and Fisher's exact test were utilized to determine the relationships between categorical data presented as numbers and percentages. All statistical tests were two-tailed and performed at a type I error α=0.05. We performed Z-tests to compare column proportions in cross-tabulations involving variables with more than two levels. All statistical tests were two-tailed and performed at a type I error (α) of 0.05.

RESULTS

Fig. 1 shows the extraction success rate in the control group and the study group, graded on a scale from 1 (unsuccessful) to 5 (full success). The median success rate in the study group was 5 (IQR=0.00), and it was the same in the control group (median=5, IQR=0.00). The Mann-Whitney U test showed a lack of significant differences in the distribution of the success scores in the two groups (p=0.657).

Absolute success (score=5) was achieved in 81.1% of the extractions with physics forceps and in 84.60% of the extractions with conventional extraction forceps. Limited success with root fracture (score=3) was observed in 10.80% of the extractions with physics forceps and in 10.40% of those with conventional forceps. The extractions with a score of 2 (limited success with osteotomy) amounted to 2.7% in the physics forceps group and to 2.6% in the conventional forceps group. Failure (score=1) was observed in 5.40% of the physics forceps extractions and in 2.6% of the conventional

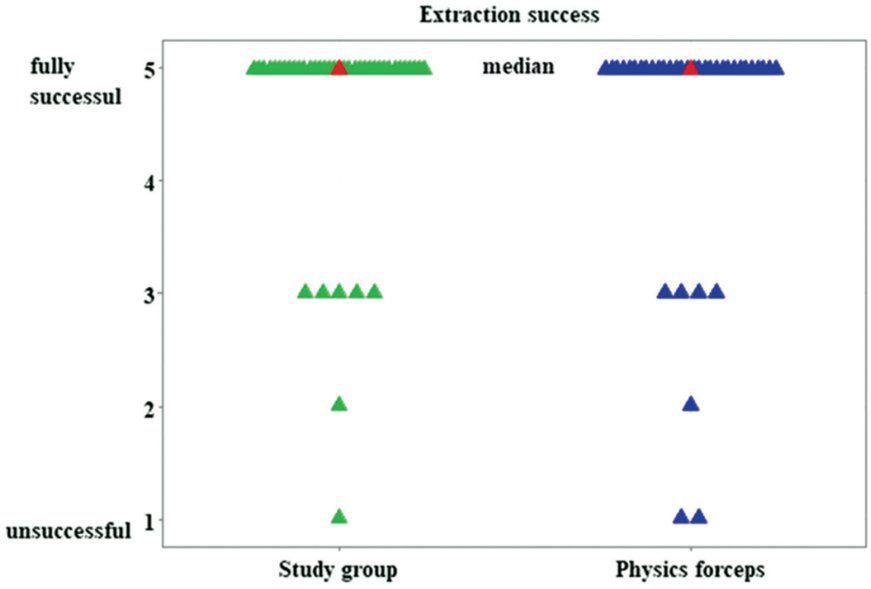

Figure 1. Distribution of the extraction success rate scores in the control and study group.

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forceps extractions. Cases with limited success with root tip fracture (score=4) were not recorded.

The buccal cortical plate was preserved in 81.1% of the extractions in the study group and 71.8% in the control group, with no statistically significant difference between the two groups (p=0.729). Detailed results are presented in **Fig. 2**. The preservation of buccal cortical plate for the extractions with physics forceps by group of teeth is presented in **Fig. 3**. The least preserved buccal bone was in the molars group, most probably due to the greater force needed for their extraction.

The results of the subjective pain intensity score measured in centimeters on the visual analogue scale (VAS) are presented in **Fig. 4**. During the healing period, both groups showed almost equal spikes and reductions in pain, with no statistically significant difference.

The healing score based on the early wound healing index (LWHI) can be seen in **Table 1**. The study group showed marginally better healing scores, yet with no statistically significant difference between the two groups.

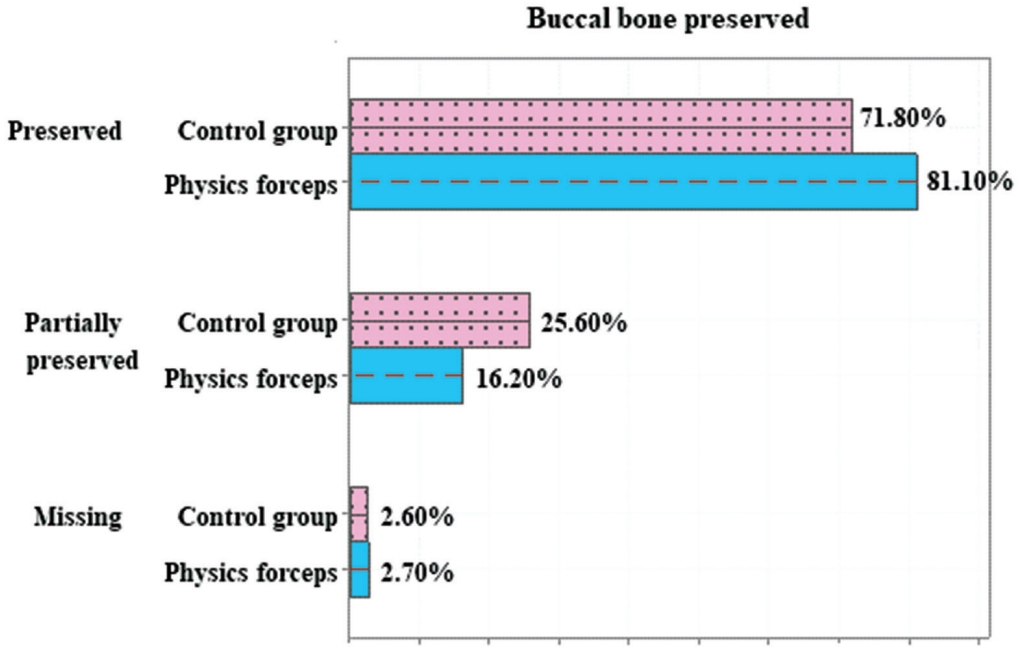

Figure 2. Buccal cortical plate preservation.

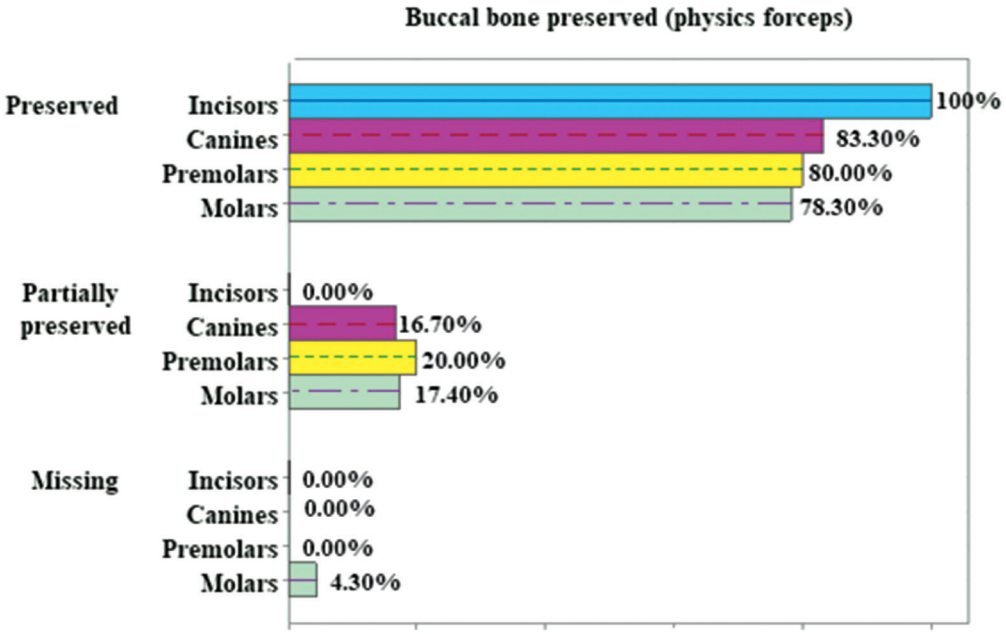

Figure 3. Buccal cortical plate preservation by tooth.

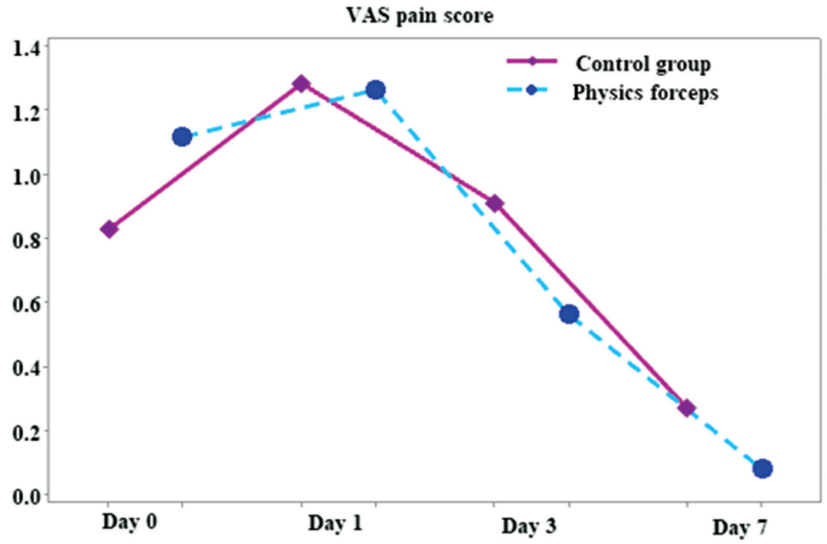

Figure 4. VAS pain intensity score.

Table 1. Early wound healing score

Early wound healing score	Physics forceps n = 26	Conventional instruments n = 28	*p*-value
	Day 3		
Very poor	0.00% (0)	0.00% (0)	N/A
Poor	84.60% (22)	78.60% (22)	0.786
Good	11.50% (3)	17.90% (5)	0.508
Very good	3.80% (1)	3.60% (1)	0.879
Excellent	0.00% (0)	0.00% (0)	N/A.
	Day 7		
Very poor	0.00% (0)	0.00% (0)	N/A
Poor	23.10% (6)	28.60% (8)	0.645
Good	26.90% (7)	35.70% (10)	0.486
Very good	38.50% (10)	21.40% (6)	0.169
Excellent	11.50% (3)	10.70% (3)	0.925
	Day 10		
Very poor	0.00% (0)	0.00% (0)	N/A
Poor	3.80% (1)	14.30% (4)	0.183
Good	7.70% (2)	7.10% (2)	0.932
Very good	30.80% (8)	28.60% (8)	0.859
Excellent	57.70% (15)	50.00% (14)	0.602

DISCUSSION

Extraction techniques, which predictably improve the success of the procedure, while causing less trauma are something that dental practitioners, and especially dental implantologists, are constantly striving for. The trauma is in direct correlation with how much hard and soft tissues will be affected and lost during the healing period.[13] Since extraction trauma is hard to avoid, a variety of socket and ridge preservation techniques have been developed, aimed at preserving the volume of the tissues present at the time of extraction. However, techniques are not entirely predictable, and may require a long waiting period for complete recovery. Therefore, aiming to be as less traumatic as possible is a must.[14,15]

In our study, we included all teeth with indications for extraction. Several similar studies exist. El-Kenawy and Ahmed[16] extract an overall of 200 teeth on patients divided in two groups – one with physics forceps and one with conventional instruments. Patole and Chidambar's[17] study is very similar, where they also perform 200 extractions in a similar manner. The study of Raghu et al.[7] includes 241

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extractions with physics forceps alone.

The studies of El-Kenawy and Ahmed[16] and Patole and Chidambar's[17] record the time it takes to perform the extractions in both groups. They both conclude that it takes considerably less time to perform the extraction with physics forceps than it takes to do so with the conventional extraction forceps. The studies of Sonune Avinash et al.[18], Patel et al.[10] and Panchal et al.[19] compare the physics forceps with the conventional extraction forceps in orthodontic extractions. They also find that it takes less time for the extractions with physics forceps. However, all these studies record the time of the extraction differently in that they consider the beginning of the extraction to be the placement of anesthesia, or from the time the patient is numb, or once the instrument is in position. This means that the results are not directly comparable.

El-Kenawy and Ahmed[16] report that a total of 83 out of 100 (83%) extractions were successful. In our study, we achieved successful extractions in 81.1% of the cases, which is on par with the results of the other study. Neither result is of statistical significance when compared with the control group. Raghu et al. report that 226 out of 241 extractions were successful, which is 93.77% and is a little bit higher than our study and that of El-Kenawy and Ahmed.

The study of Choi and Bae[9] performs planned replantation of 96 teeth. They mobilize the teeth with braces and then extract them with physics forceps. Their results show that about 93% of the extractions occur successfully. This matches the results reported by El-Kenawy and Ahmed, but given the fact that teeth were already mobile, the overall success would otherwise be closer to what the studies of El-Kenawy and Ahmed and our study achieved.

It is a well-established understanding that after a tooth extraction, the hard and soft tissues undergo remodeling and are ultimately reduced.[20] The loss of a tooth leads to the initiation of resorption processes, which mainly affect the bone on the buccal side of the extraction site.[21] Even with the use of ridge preservation techniques, the soft tissues, too, do not remain unaffected with a predominant change in their buccal contour.[22] The bumper of the physics forceps aims to support the buccal tissues and counteract the extraction forces, preserving the buccal cortical plate and the soft tissues over it intact.

In our study, of all the physics forceps extractions, in 81.10% of the cases the buccal cortical plate remained intact (preserved). There was no statistically significant difference in comparison with the control group. In the studies of both El-Kenawy and Ahmed and Patole and Chidambar, there were only 3 cases (3%) of buccal cortical plate fracture. The results of Raghu et al. show that 35 of 241 cases had a buccal cortical plate fracture, which means that the cortical plate was intact in 85.48% of the cases, which somewhat coincides with our findings.

The studies of El-Kenawy and Ahmed and Patole and Chidambar and our study all show that, even though with no statistically significant difference, there were less buccal cortical plate fractures in the study group in comparison to the control group. However, the results of the orthodontic extractions in the study of Sonune Avinash et al.[18] had more buccal cortical plate fractures with the physics forceps.

In our study, we followed up the extractions for up to 10 days and evaluated the extraction wound healing using the LWHI. While the physics forceps extractions showed marginally better results, there was no statistically significant difference between the two groups. Patole and Chidambar[17] report that 89% of the extraction wounds in the study group had healed. This is in contrast with our study where we found that only about 50% of the extractions with physics forceps had healed. However, on the 10th day 88.5% of the wounds had healed, which matches the results of the other study.

Limitations

We acknowledge that the lack of appropriately calculated patient sample size for the study is a major limitation, which might have an impact on the ultimate credibility of the results presented.

CONCLUSIONS

Atraumatic extractions allow for more hard and soft tissues to be preserved in the extraction site. Physics forceps are a tool that many practitioners are familiar with, but they are used differently than traditional extraction forceps. However, this might allow for a quicker getting used to. Although the clinical reports show mixed results with marginally better outcomes for the physics forceps, the fact that the extractions are quicker and the instrument is not much different than the well-known conventional counterpart, it might be considered an appropriate upgrade to atraumatic extraction armamentarium in modern dentistry.

Ethical statement

The study was approved by the Ethics Committee of the Medical University of Plovdiv.

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Competing Interests

The authors have declared that no competing interests exist.

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Минимально инвазивное удаление с помощью физических щипцов – клиническая оценка и сравнение

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Резюме

Введение: Удаление зубов по-прежнему остаётся одной из наиболее распространённых стоматологических процедур, которые регулярно выполняются по разным причинам. Щипцы и элеваторы для удаления зубов — хорошо известные инструменты для удаления зубов, которые уже более ста лет являются стандартом в процедурах удаления зубов. Физические щипцы — одна из возможных альтернатив, позволяющая выполнить менее травматичное и более предсказуемое удаление.

Материалы и методы: Все пациенты в исследовании были разделены на две группы: 26 пациентов, для которых использовались обычные щипцы для экстракции (контрольная группа), и 28 пациентов, для которых мы использовали физические щипцы (основная группа). Для каждой группы мы оценивали успешность удаления, сохранение кортикальной пластинки щеки, ощущение боли и раннее заживление ран.

Результаты: Статистически значимой разницы в показателях успешности экстракции между двумя группами не наблюдалось. При экстракции физическими щипцами буккальная кортикальная пластинка сохранилась в 81.1% случаев, а при экстракции традиционными щипцами – в 71.8%. Пациенты основной группы сообщили об уменьшении боли на седьмой день. На десятый день в исследовательской группе доля полностью зажывших экстракционных ран была немного выше.

Заключение: При атравматическом удалении сохраняется больше твёрдых и мягких тканей в месте удаления. Физические щипцы – это инструмент, аналогичный широко известным обычным щипцам для удаления зубов. Они обеспечивают несколько лучшие результаты в большинстве экстракций.

Ключевые слова

атравматичный, малоинвазивный, физические щипцы, удаление зубов