The impact on bone tissues of immediate implant-supported mandibular overdentures with cusped and cuspless teeth

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ABSTRACT

الأهداف: تهدف هذة الدراسة إلى معرفة التأثيرات العظمية للأطقم السفلية الفوق سنية والمدعمة بزرعات الأسنان الفورية سواء كانت ذات حدبات سنية أو عديمة الحدبات السنية.

الطريقة: هذه دراسة منضبطة عشوائية تم إجراؤها في عيادة الأسنان بكلية طب الأسنان بجامعة الأزهر، فرع أسيوط في مصر، و ذلك في فترة 12 شهراً (2013 إلى 2014). تم علاج 20 مريض بإستخدام الأطقم الفوق سنية والمدعمة بزرعات الأسنان الفورية، حيث تم تقسيم المرضى إلى مجموعتين: مجموعة عولجت بأطقم لديها حدبات سنية و الأخرى عولجت بأطقم عديمة الحدبات. تم بعد ذلك تقييم معدل نجاح الزرعات سريرياً وشعاعياً مباشرة بعد التركيب وكذلك كل 3 أشهر ، 6 أشهر، 9 أشهر و 12 شهراً. البيانات تم جمعها بإستخدام الإستبيانات و إستمارات ملاحظة المرضى وصور الأشعة السينية. ثم تم تحليل البيانات بإستخدام برنامج التحليل الإحصائي (إس بس إس النسخة 20).

النتائج: الأطقم ذات الحدبات السنية أظهرت تحسناً ملحوظاً (ذو دلالة معنوية) بالنسبة للمعايير السريرية والتي تشمل غياب تحرك الزرعات السنية و غياب الألم و إرتشاف العظم مقارنة بالأطقم عديمة الحدبات، بينما لم توجد فروق ذات دلالة معنوية بين المجموعتين بالنسبة لشفافية العظم المحيط بالزرعات. كذلك لم توجد فروق ذات دلالة معنوية بين المجموعتين بالنسبة لمستوى العظم مباشرة بعد التركيب أو بعد 3 أشهر ولكنها وجدت بعد 6 أشهر 9 أشهر و 12 شهراً من التركيب.

الخاتمة: إن الأطقم الفوق سنية المدعمة بالزرعات الفورية ذات الحدبات السنية أكثر كفاءة بالنسبة للكثير من المعايير السريرية مقارنة بالأطقم عديمة الحدبات السنية.

Objectives: To examine the effects on bone tissues of immediate implant-supported mandibular overdentures with cusped or cuspless teeth.

Methods: A randomized controlled trial was conducted at the Dental Clinic, Faculty of Dentistry, Al-Azhar University, Assiut Branch, Egypt, over a 12-month period from September 2013 to September 2014. Twenty patients were treated with immediate implant-supported overdentures: one group received overdentures with cusped teeth, and the other group received overdentures with cuspless teeth. The rate of implant success was assessed clinically and radiographically at 3, 6, 9, and 12 months. The data were collected by a questionnaire, an observation checklist, and radiography. The data were then analyzed using computerized methods.

Results: Overdentures with cusped teeth showed a significant improvement in the clinical criteria, including the absence of clinical implant mobility, pain, and bone resorption, while the clinical criteria for the absence of peri-implant radiolucency were insignificantly different between the 2 groups ($p>0.05$). There were no significant differences in the clinical evaluations for bone levels at the time of insertion or 3 months after insertions, while significant differences were found at 6, 9, and 12 months after insertion.

Conclusion: Overdentures with cusped teeth supported by immediate implants were found superior regarding many clinical criteria than those cuspless counterparts.

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As the life span increases, significant damage occurs to the teeth. Treating edentulous patients can be a demanding challenge.[1] Implants in mandibular retained overdentures could be an effective method for the treatment of these patients;[2] the success of maxillary implant overdentures was 86.6%, and the success of mandibular implant overdentures was 95.8%.[3] Implant-supported overdentures have been preferred over complete dentures due to their simplicity and improved patient quality of life.[1-4] The roots have been used beneath overdentures in cases with almost hopeless mandibular dentition. The overdenture design was found to be highly effective in the mandible and has been popularly accepted,[5] allowing the root-to-crown ratio to increase, and the prognosis of the remaining teeth to improve. It also seems that the presence of the vertical periodontal ligament preserves the alveolar ridge morphology.[6,7] Mainly, 3 impressions have been widely utilized to treat the edentulous jaw, including fixed prostheses supported with implants, removable overdentures supported with implants, and implant overdentures supported with soft tissue.[8] The immediate implants are located at diseased and non-diseased sites.[9] Immediately after extraction, placing the implant at a site with endodontic infection has resulted in a good substitution for complete dentures.[10] Today, the problem is facilitated by the use of implants. The utilization of 4 implants is now common and popularly acceptable. In one case study of a treatment concept using Biohorizons™ Tapered Internal Implants, it was found that the use of the 4-implant concept had many advantages and good success.[11] Cusped teeth have advantages, such as their effectiveness, the balance of occlusion, the definitive point of relationship between the upper and lower posterior teeth, and their acceptability and compatibility. Cuspless teeth have some advantages, such as resistance to non-masticatory mobility and the absence of harm to supporting tissue. The use of natural teeth with cusps leads to instability of the dentures, which could not be overcome.[12] There has been a lack of evidence for the effectiveness of immediate implant-supported mandibular overdentures. The use of 2-implant mandibular overdentures for edentulous patients is affordable and cost-effective. The overdenture design was found to be highly effective in the mandible and has been popularly accepted. This study aimed to examine the impact on the surrounding bone tissue of immediate implant-supported mandibular overdentures with cusped or cuspless teeth.

Methods. A randomized controlled trial was conducted at the Dental Clinic, Faculty of Dentistry at Al-Azhar University, Assiut Branch in Egypt, over 12 months (September 2013-2014). Twenty patients presenting with hopeless anterior mandibular teeth were selected by convenience sampling and met the following criteria: age >40 years old; no systematic diseases; non-smoker; jaw relation angle class one; refused removable partial dentures; edentulous more than 3 years; and hopeless mandibular teeth. Diabetic patients, hypertensive patients, patients who preferred removable partial dentures and immunodeficient patients were excluded. The randomization of the selected patients was by lottery selection after providing each patient with a number from a list, and the 20 patients were then randomly divided into 2 groups, with 10 patients in each group. Group one underwent rehabilitation with immediate implants (the implant inserted immediately after extraction) loaded with overdentures with cusped teeth. Group 2 was rehabilitated with immediate implants (implants inserted immediately after extraction) loaded with overdentures with cuspless teeth. After flap assessment, the extraction of a tooth and insertion installation inside the socket, clinical estimations were performed to describe the measurement of the surrounding bone, as well as the minimal deformity. There were no layers or filler material utilized. The flaps were hence supplanted and secured with sutures in such a manner that the healing top of the implant was presented to the oral environment. After 3 months of healing, a reentry technique was performed, and the clinical estimations were performed again. The researcher searched the PubMed database and Google to identify other related research on cusped and cuspless teeth with immediate implant-supported overdentures.

This study was approved by the Dental Health Department of the Faculty of Applied Medical Sciences, Albaha University, Albaha, Kingdom of Saudi Arabia. Consent forms were completed by all of the participants. The experiment was conducted with the understanding and the consent of the human subjects. The study was performed according to principles of the Helsinki Declaration of no harm to any participants.

The 20 patients, once the hopeless teeth were removed, were treated by overdentures supported by immediate implants in the jaw. They were divided into 2 groups: one receiving overdentures with cusped teeth and the second receiving overdentures with cuspless teeth. The patients received 80 titanium implants

inserted at the mental symphysis (each patient received 4 implants). The implant system used was the Frialoc (Friatec, AG Mannheiti, Germany). The U-shaped titanium bars were fabricated and then connected to the implants and overdentures. The cuspless teeth were acrylic (8PCS/1SET, 12SETS/1BOX), while the cusp angle was 0° (Yamahoci Dental Manufacturing Co., Spain).[13] The rate of implant success was clinically evaluated with the specific criteria described below and radiographically by x-ray (digital dental x-ray) using periapical views at 3, 6, 9, and 12 months post-implantation.

The data were collected from the 2 groups by a questionnaire for demographic characteristics. The outcomes were measured by primary and secondary outcomes. The primary endpoint was the crestal bone loss observed over one year, and the secondary endpoints were periapical lesions, pain, neural sensitivity, and mobility of the implants. The following criteria were applied for bone level measurement: no evidence of mobility of implants in any direction, no radiolucency around the implant, no pain and no proven signs of bone resorption and neural lesion. Radiographically, the bone level was used. One week after insertion, a periapical radiograph was obtained. The bone level was measured from the apex of the implant to the level of the crestal bone, and this measurement was used as a baseline measure; then, after 3, 6, and 12 months, the bone level was measured. The measurement of crestal bone loss by periapical radiographs was evaluated by the mesial and distal marginal bone height around the abutments (implant) from the radiographs of each patient as follow: 2 points were marked, one at the apex of the implant and the other at the tip of the implant; a line (A) was drawn connecting the 2 points and then a tangent (b) to the tip of the tooth; marginal bone height was measured using dial calipers from the mesial and distal alveolar crest to line (b); and the measurements on serial radiographs were compared, and the results were statistically analyzed as means and percentages. The mobility was assessed according to the periotest (Siemens Dental Bensheim, Germany)[14] and by anteroposterior distributions of loaded forces. A visual analog scale was used for pain assessment.

Periapical lesions were measured at 3, 6, 9, and 12 months in the cross-section of the widest and deepest areas by the researcher, using precision digital calipers. The distance was measured and represented in millimeters (mm) then was converted to a percentage. Pain was measured at 3, 6, 9, and 12 months by a visual analog scale, which was used to assess the pain experienced by the patients; then, the average of each patient was calculated and reported as a percentage. Neural sensitivity was measured at 3, 6, 9, and 12 month by pulp sensibility testing, which included electrical testing that extrapolated pulp health from the sensory response.

The data were analyzed by computerized methods using the Statistical Package for the Social Sciences version 20 (IBM Corp., Armonk, New York, USA). Descriptive analysis of demographic characteristics was conducted. The chi-square test was used to test differences in patients' demographic characteristics between the 2 groups. The independent t-test was used to identify differences between the 2 groups at different times. All of the values were tabulated as averages (means) and standard deviations (SDs). *P*-values less than 0.05 were considered significant at a 95% level of confidence.

Results. As shown in **Table 1**, 20 patients participated in this study who were homogenous in the demographic characteristics, such as age and education ($p>0.05$). The findings in **Table 2** show that there were significant improvements in implant mobility, pain, and bone resorption with overdentures, while the clinical criteria for the absence of peri-implant radiolucency were not at a significant level between the 2 groups after 12 months of follow-up. **Table 2** also shows that the 2 groups were homogenous at the time of insertion. There were no significant differences in the mean values of clinical evaluation by x-ray for bone levels at the time of insertion or 3 months after insertions, but there were significant differences at 6, 9, and 12 months after insertion, as shown in **Table 3**. The bone loss at insertion of the implant was similar between the 2 groups at baseline, while it was significantly higher in the cuspless group than in the cusped teeth group, as shown in **Table 4**.

Table 1 - Characteristics of group one and group 2 patients who participated in a dental study.

Variable	Group 1	Group 2
	n (%)	
Patient education		
Illiterate	9 (90.0)	8 (80.0)
Primary	1 (10.0)	2 (20.0)
Age of patient	52.34 ± 1.76	51.98 ± 1.64
Edentulous years	5.0 ± 0.9	4 ± 0.45

Table 2 - Comparison of the clinical criteria for the first groups of overdentures with cusped teeth, and the second group with cuspless teeth after bar removal.

Variables	Group 1	Group 2 (%)	*P*-value
At insertion			
Absence of clinical mobility of implants	78	75	0.16
No radiolucency around the implant	83	7	0.61
Absence of pain and clinical signs of neural lesions	76	82	0.11
Bone resorption	87	74	0.09
After 12 months			
Absence of clinical mobility of implants	80	70	0.04*
Absence of peri-implant radiolucency	80	75	0.10
Absence of pain and clinical signs of neural lesions	90	80	0.04*
Bone resorption	95	80	0.03*

* Significant

Table 3 - Comparison of the means and standard deviations of the clinical evaluation of bone loss for the first group with overdentures with cusped teeth and second group with cuspless teeth at different times.

Time of evaluation	Group 1 Mean ± SD	Group 2 Mean ± SD	*P*-value
At insertion	1.10 ± 0.35	1.2 ± 0.38	0.23
3 months	1.40 ± 0.31	1.6 ± 0.32	0.14
6 months	1.45 ± 0.37	1.8 ± 0.36	0.04*
9 months	1.52 ± 0.43	1.9 ± 0.35	0.03*
12 months	1.63 ± 0.36	2.1 ± 0.38	0.02*

* Significant, SD - standard deviation

Table 4 - Comparison of the average bone loss for the first group with overdentures with cusped teeth, and second group with cuspless teeth at insertions and after one year.

Time and groups	Average bone loss <0.5 mm	0.5-<1 mm	>1 mm	*P*-value
	n (%)			
At insertion				
Group 1	9 (90)	1 (10)	0 (0)	0.3
Group 2	8 (80)	1 (10)	1 (10)	
After one year				
Group 1	8 (80)	1 (10)	1 (10)	0.01*
Group 2	7 (70)	2 (10)	1 (10)	

* Significant

Discussion. This study was conducted among 20 patients, divided into 2 groups homogenous in age and gender, to examine the impact on surrounding bone tissues of immediate implant-supported mandibular overdentures with cusped or cuspless teeth. It was found that overdentures with cusped teeth were more effective according to clinical and radiographic evaluations at different times than cuspless teeth. Our findings were similar to those of a study conducted to assess the placement of implants in a molar region, which was a randomized follow-up study 12 months in length and showed that noticeable changes occurred in edentulous site. Thus, not only the dimension of the palate but also the height of the bone was reduced.[15]

This study showed that there was an absence of clinical mobility of implants, pain, clinical signs, and bone resorption with cusped tooth overdentures that was more significant than with cuspless teeth overdentures, while the clinical criteria for the absence of peri-implant radiolucency were not significant between the 2 groups. In one study,[16] it was advised that the assignment of an implant immediately after extraction might neutralize the ridge after tooth removal. A report by Evans and Chen[17] showed, over an 18 month period after type I placement, that there was an approximately 1.7 mm decrease in bone height and an approximately one mm recession of the buccal soft tissue. In addition, it has been proved that implants located directly within the extraction socket influenced treatment outcomes. Moreover, the retention and stability of removable dentures were considered to be factors having effects on patients' preferences and satisfaction.[17] Furthermore, this study was comparable to a study performed in Egypt[18] to assess the effects of both cusped and cuspless teeth with immediate implants in the mandible after tooth removal. The Egyptian study[18] showed that overdentures with cuspless teeth showed little significant difference from those with cusped teeth. The findings of this study were unique in exploring the beneficial effects of cusped teeth for patients. However, patient satisfaction was not correlated with cusped or cuspless teeth for many years. This study emphasized the superiority of cusped teeth in implant-supported overdentures.

In conclusion, supported overdentures with immediate implants with cusped teeth had more significant success according to clinical criteria, such as

absence of tooth mobility, pain, and bone resorption, and clinical evaluation than that with cuspless teeth at different times. The superiority of cusped teeth over cuspless teeth might be justified because the cusp height and angle of all of the posterior teeth are properly related to the pathways of the mandible and its satisfactory use. The strengths of this study included its comparison of 2 different methods of implant-supported mandibular overdentures, which are 2 of the most cost-effective methods, and the long evaluation period (12 months). The study provided significant findings that cusped teeth were preferred to cuspless teeth, using clinical criteria and clinical evaluation. The study limitations were that it was conducted among only 20 patients; such studies will yield more useful results if conducted in larger sample sizes from across the country.

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